AMERICAN NATIONAL STANDARD

SAMPLING PROCEDURES AND TABLES FOR INSPECTION BY VARIABLES FOR PERCENT NONCONFORMING

PREPARED BY
AMERICAN SOCIETY FOR QUALITY CONTROL STANDARDS COMMITTEE
FOR
AMERICAN NATIONAL STANDARDS COMMITTEE
Z-1 ON QUALITY ASSURANCE

SPONSOR AND SECRETARIAT
AMERICAN SOCIETY FOR QUALITY CONTROL

Abstract

Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming is an acceptable sampling system to be used on a continuing stream of lots for AQL specified. It provides tightened, normal, and reduced plans to be used on measurements which are normally distributed. Variation may be measured by sample standard deviation, sample range, or known standard deviation. It is applicable only when the normality of the measurements is assured.

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Foreword

(This foreword is not a part of American National Standard - Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming, Z1.9-1993)

This standard is a revision of ANSI/ASQC Z1.9-1972, "Sampling Procedures and Tables for Inspection by Variables for Percent Defective", which corresponds directly to the military standard MIL-STD-414. The present revision ANSI/ASQC Z.1-1993 was undertaken to allow complete interchangeability of the tabulated plans with ISO/DIS 3951, which provides a graphical means for implementation of the plans. ANSI/ASQC Z1.9-1993 is also roughly matched to ANSI Z1.4, which corresponds directly to the military standard MIL-STD-105D. The matching is sufficient to allow inspection under either standard for stated AQLs and Inspection Levels with reasonably equivalent protection. Tables are given in Appendix E which shows differences in protection between ANSI Z1.9-1993 and ANSI Z1.4. These are for use in critical applications to determine whether moving from one standard to the other is appropriate.

The tables and procedures contained herein are those of the original MIL-STD-414, suitably modified to achieve correspondence with the aforementioned ISO/DIS 3951 and matching with MIL-STD-105D. These modifications include:

1. Rearranging the code letters assigned to the various plans by eliminating the plans for the original codes J and L and dropping the symbol O. The codes were then relettered alphabetically.
2. Relabeling the original Inspection Levels I,II,III,IV,V as S3,S4,I,II,III.
3. Adjusting lot size ranges corresponding to various inspection levels to match MIL-STD-105D.
4. Deleting original AQLs: 0.04,0.065 and 15.00 percent. (Users who wish to use these AQL values should refer to MIL-STD-414.)
5. Replacing the original rules for switching and discontinuance of inspection by those of MIL-STD-105D (slightly revised).
6. Deletion of Section A2 on "Classification of Defects" and substituting a new section on "Definitions and Terminology" which refers to ANSI/ASQC Standard A2-1987 as a reference source for terminology and definitions. ANSI/ASQC Z1.6-1987 contains modifiers for the degree of seriousness of defects to be used in defect classifications.
7. Deletion of Section A8 on "Estimation of Process Average" and substituting a new section calling attention to the need for verifying the assumption of normality of the underlying distribution of individual measurements.
8. Substitution of the word "nonconformity" for "defect", "nonconformance" for "defective", and "percent nonconforming" for "percent defective" throughout.
9. Addition of an appendix showing the match between Z1.9-1993 and Z1.4.

NOTE: A compatible and interchangeable graphical version of this standard is contained in ISO/DIS 3951.

Suggestions for improvement of this standard will be welcome. They should be sent to the standard's sponsor, ASQC. Committee members serving as writers and editors of this standard were:

Joseph M. Califano, Chairperson
Michael Yargosz
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INTRODUCTION

This Standard was prepared to meet a growing need for the use of standard sampling plans for inspection by variables in procurement, supply and storage, and maintenance inspection operations. The variables sampling plans apply to a single quality characteristic which can be measured on a continuous scale, and for which quality is expressed in terms of percent nonconforming. The theory underlying the development of the variables sampling plans, including the operating characteristic curves, assumes that measurements of the quality characteristics are independent, identically distributed normal random variables.

It is important to note that variables sampling plans are not to be used indiscriminately, simply because it is possible to obtain variables measurement data. In considering applications where the normality or independence assumptions may be questioned, the user is advised to consult his technical agency to determine the feasibility of application.

In comparison with attributes sampling plans, variables sampling plans have the advantage of usually resulting in considerable savings in sample size for comparable assurance as to the correctness of decisions in judging a single quality characteristic, or for the same sample size, greater assurance is obtained using variables plans. Attributes sampling plans have the advantage of greater simplicity, of being applicable to either single or multiple quality characteristics, and of requiring no knowledge about the distribution of the continuous measurements of any of the quality characteristics.

This Standard is divided into four sections. Section A describes general procedures of the sampling plans. Sections B and C describe specific procedures and applications of the sampling plans when variability is unknown. In Section B the estimate of lot standard deviation is used as the basis for an estimate of the unknown variability, and in Section C the average range of the sample is used. Section D describes the plans when variability is known.

Each of Section B, C, and D is divided into two parts: (I) Sampling Plans for the Single Specification Limit Case, and (II) Sampling Plans for the Double Specification Limit Case. For the single specification limit case, the acceptability criterion is given in two forms: Form 1 and Form 2. Either of the forms may be used, since they are identical as to sample size and decision for lot acceptability or rejectability. In deciding whether to use Form 1 or Form 2, the following points should be borne in mind. Form 1 provides the lot acceptability criterion without estimating lot percent nonconforming. The Form 2 lot acceptability criterion requires estimates of lot percent nonconforming.

Operating Characteristic Curves in Table A-3 are for the Normal Sampling Plans and show the relationship between quality and percent of lots expected to be acceptable for the quality characteristic inspected. As stated, these Operating Characteristic Curves are based on the assumption that measurements are selected at random from a normal distribution.

The corresponding sampling plans in Sections B, C, and D were matched as closely as possible under a system of fixed sample size with respect to their Operating Characteristic Curves. Operating Characteristic Curves in Table A-3 have been computed for the sampling plans based on the estimate of lot standard deviation of unknown variability. They are equally applicable for sampling plans based on the average range of the sample of unknown variability and those based on known variability.

Certain characteristics concerning the sampling plans in Section B and C and those in Section D should be noted. Plans based on the estimate of unknown variability require fewer sample units for comparable assurance when the estimate of lot standard deviation is used than when the average range of the sample is used; on the other hand, plans using the average range of the sample require simpler computations. Plans using known variability require considerably fewer sample units for comparable assurance than either of the plans of unknown variability; however, the requirement of known variability is a stringent one. The user is well advised to consult a statistician before applying sampling plans using known variability.

Table B-6 provides values of the factor F to compute the maximum standard deviation: MSD. The MSD serves as a guide for the magnitude of the estimate of lot standard deviation when using plans for the double specification limit case, based on the estimate of lot standard deviation of unknown variability. Similarly Table C-6 provides values of the factor f to compute the maximum average range: MAR. The MAR serves as a guide for the magnitude of the average range of the sample when using plans for the double specification limit case, based on the average range of the sample of unknown variability. The estimate of lot standard deviation or average range of the sample, if it is less than the MSD or MAR, respectively, helps to insure, but does not guarantee, lot acceptability.

All symbols and their definitions are given in the appendix of the applicable section. An illustration of the computations and procedures used in the sampling plans is given in the examples of Parts I and II of the applicable section. The computations involve simple arithmetic operations such as addition, subtraction, multiplication, and division of numbers, or at most, the taking of a square root of a number. The user should become familiar with the general procedures of Section A, and refer to the applicable section for detailed instructions regarding specific procedures, computations, and tables for the sampling plans.

The Appendix—Section E—provides information about the match between this variables standard, ANSI/ASQC Z1.9-1993, and the corresponding attributes standard, ANSI Z1.4.

SECTION A

GENERAL DESCRIPTION OF SAMPLING PLANS

A1. SCOPE

A1.1 Purpose. This Standard establishes sampling plans and procedures for inspection by variables for use in procurement, supply and storage, and maintenance inspection operations. When applicable this Standard shall be referenced in the specification, contract, or inspection instructions, and the provisions set forth herein shall govern.

A1.2 Inspection. Inspection is the process of measuring, examining, testing, gauging, or otherwise comparing the "unit or product" (See A1.4) with the applicable requirements.

A1.3 Inspection by Variables. Inspection by variables is inspection wherein a specified quality characteristic (See A1.5) on a unit of product is measured on a continuous scale, such as pounds, inches, feet per second, etc., and a measurement is recorded.

A1.4 Unit of Product. The unit of product is the entity of product inspected in order to determine its measurable quality characteristic. This may be a single article, a pair, a set, a component of an end product, or the end product itself. The unit of product may or may not be the same as the unit of purchase, supply, production, or shipment.

A1.5 Quality Characteristic. The quality characteristic for variables inspection is that characteristic of a unit of product that is actually measured to determine conformance with a given requirement.

A1.6 Specification Limits. The specification limit(s) is the requirement that a quality characteristic should meet. This requirement may be expressed as an upper specification limit; or a lower specification limit, called herein a single specification limit; or both upper and lower specification limits, called herein a double specification limit.

A1.7 Sampling Plans. A sampling plan is a procedure which specifies the number of units of product from a lot which are to be inspected, and the criterion for acceptability of the lot. Sampling plans designated in this Standard are applicable to the inspection of a single quality characteristic of a unit of product. These plans may be used whether procurement inspection is performed at the plant of a prime contractor, subcontractor or vendor, or at destination, and also may be used when appropriate in supply and storage, and maintenance inspection operations.

A2. DEFINITIONS AND TERMINOLOGY

The definitions and terminology employed in this standard are in accord with ANSI/ASQC Standard A2-1987 (Terms, Symbols, and Definitions for Acceptance Sampling Involving the Percent or Proportion of Variant Units in a Lot or Batch). The following two definitions are of particular importance in application of this standard:

> DEFECT: A departure of a quality characteristic from its intended level or state that occurs with a severity sufficient to cause an associated product or service not to satisfy intended normal, or foreseeable, usage requirements.
>
> NONCONFORMITY: A departure of a quality characteristic from its intended level or state that occurs with severity sufficient to cause an associated product or service not to meet a specification requirement.

These acceptance sampling plans for variables are given in terms of the percent or proportion of product in a lot or batch that depart from some requirement. The general terminology used within the document will be given in terms of percent of nonconforming units or number of nonconformities, since these terms are likely to constitute the most widely used criteria for acceptance sampling.

A3. PERCENT NONCONFORMING

A3.1 Expression of Nonconformance. The extent of nonconformance of product shall be expressed in terms of percent nonconforming.

A3.2 Percent Nonconforming. The percent nonconforming for a quality characteristic of a given lot of product is the number of units of product nonconforming for that characteristic divided by the total number of units of product and multiplied by one hundred. Expressed as an equation: Percent nonconforming =

$$\frac{\text{Number of nonconforming units}}{\text{Number of units}} \times 100$$

A4. ACCEPTABLE QUALITY LEVEL

A4.1 Acceptable Quality Level. The acceptable quality level (AQL) is defined as the maximum percentage or proportion of nonconforming units in a lot or batch that, for purposes of acceptance sampling, can be considered satisfactory as a process average. The acceptable quality level is a nominal value expressed in terms of percent nonconforming specified for a single quality characteristic. Certain numerical values of AQL ranging from .10 to 10.00 percent are shown in Table A-1. When a range of AQL values is specified, it shall be treated as if it were equal to the value of AQL for which sampling plans are furnished and which is included within the AQL range. When the specified AQL is a particular value other than those for which sampling plans are furnished, the AQL, which is to be used in applying the provisions of this Standard, shall be as shown in Table A-1.

A4.2 Specifying AQLs. The particular AQL value to be used for a single quality characteristic of a given product must be specified. In the case of a double specification limit, either an AQL value is specified for the total percent nonconforming outside of both upper and lower specification limits, or two AQL values are specified, one for the upper limit and another for the lower limit.

A5. SUBMITTAL OF PRODUCT

A5.1 Lot. The term "lot" shall mean "inspection lot," i.e., a collection of units of product from which a sample is drawn and inspected to determine compliance with the acceptability criterion.

A5.1.1 Formation of Lots. Each lot shall, as far as is practicable, consist of units of product of a single type, grade, class, size, or composition manufactured under essentially the same conditions.

A5.2 Lot Size. The lot size is the number of units of product in a lot, and may differ from the quantity designated in the contract or order as a lot for production, shipment, or other purposes.

A6. LOT ACCEPTABILITY

A6.1 Acceptability Criterion. The acceptability of a lot of material submitted for inspection shall be determined by use of one of the sampling plans associated with a specified value of the AQL(s). This Standard provides sampling plans based on known and unknown variability. In the latter case two alternative methods are provided, one based on the estimate of lot standard deviation and the other on the average range of the sample. These are referred to as the standard deviation method and the range method. For the case of a single specification limit, the acceptability criterion is given in two forms. These are identified as Form 1 and Form 2.

A6.2 Choice of Sampling Plans. Sampling plans and procedures are provided in Section B if variability is unknown and the standard deviation method is used, in Section C if variability is unknown and the range method is used, and in Section D if variability is known. Unless otherwise specified, unknown variability, standard deviation method sampling plans, and the acceptability criterion of Form 2 (for the single specification limit case) shall be used.

A7. SAMPLE SELECTION

A7.1 Determination of Sample Size. The sample size is the number of units of product drawn from a lot. Relative sample sizes are designated by code letters. The sample size code letter depends on the inspection level and the lot size. There are five inspection levels: Special Levels S3, S4, and General Levels I, II and III. Unless otherwise specified, Inspection Level II shall be used. However, Inspection Level I may be specified when less discrimination is needed, or Level III may be specified for greater discrimination. Levels S3 and S4 may be used when relatively small sample sizes are necessary and large sampling risks can or must be tolerated. The sample size code letter applicable to the specified inspection level and for lots of given size shall be obtained from Table A-2.

A7.2 Drawings of Samples. A sample is one or more units of product drawn from a lot. Units of the sample shall be selected without regard to their quality.

A8. NORMALITY ASSUMPTION

This standard assumes the underlying distribution of individual measurements to be normal in shape. Failure of this assumption to be valid will affect the OC curves and probabilities based on these curves. In particular it will affect the estimate of percent nonconforming calculated from the mean and standard deviation of the distribution. The assumption should be verified prior to use of the standard.

A variety of statistical tests and graphical techniques are available for this purpose. A person knowledgeable in statistics should be consulted who can advise whether the distribution appears suitable for sampling by variables.

A9. SPECIAL PROCEDURE FOR APPLICATION OF MIXED VARIABLES-ATTRIBUTES SAMPLING PLANS

A9.1 Applicability. A mixed variables and attributes sampling plan may be used under either of the two following conditions: (Note: No Operating Characteristic Curves are provided for the mixed variables-attributes sampling plans herein and those in Table A-3 are not applicable.)

Condition A. Ample evidence exists that the product submitted for inspection is selected by the supplier to meet the specification limit(s) by a screening process from a larger quantity of product which is not being produced within the specification limit(s).

Condition B. Other conditions exist that warrant the use of a variables-attributes sampling plan.

A9.2 Definitions.

A9.2.1 Inspection by Attributes. Inspection by attributes is inspection wherein the unit of product is classified simply as a nonconforming unit or conforming with respect to a given requirement or set of requirements.

A9.2.2 Mixed Variables-Attributes Inspection. Mixed variables-attributes inspection is inspection of a sample by attributes, in addition to inspection by variables already made of a previous sample, before a decision as to acceptability or rejectability of a lot can be made.

A9.3 Selection of Sampling Plans. The mixed variables-attributes sampling plan shall be selected in accordance with the following:

A9.3.1 Select the variables sampling plan in accordance with Section B, C, or D.

A9.3.2 Select the attributes sampling plan from ANSI Z1.4 (MIL-STD-105D) using a single sampling plan and tightened inspection. The same AQL value(s) shall be used for the attributes sampling plan as used for the variables plan of paragraph A9.3.1.

(Additional sample items may be drawn, as necessary, to satisfy the requirements for sample size of the attributes sampling plan. Count as a nonconforming unit each sample item falling outside of specification limit(s).)

A9.4 Determination of Acceptability. A lot meets the acceptability criterion if one of the following conditions is satisfied:

Condition A. The lot complies with the appropriate variables acceptability criterion of Section B, C. or D.

Condition B. The lot complies with the acceptability criterion of ANSI Z1.4.

A9.4.1 If Condition A is not satisfied, proceed in accordance with the attributes sampling plan to meet Condition B.

A9.4.2 If Condition B is not satisfied, the lot does not meet the acceptability criterion.

A10. NORMAL, TIGHTENED AND REDUCED INSPECTION

A10.1 Initiation of Inspection. Normal inspection will be used at the start of inspection unless otherwise directed by the responsible authority.

A10.2 Continuation of Inspection. Normal, tightened or reduced inspection shall continue unchanged on successive lots or batches except where the switching procedures given below require change.

A10.3 Switching Procedures.

A10.3.1 Normal to Tightened. When normal inspection is in effect, tightened inspection shall be instituted when 2 out of 5 consecutive lots or batches have been rejected on original inspection (i.e., ignoring resubmitted lots or batches for this procedure).

A10.3.2 Tightened to Normal. When tightened inspection is in effect, normal inspection shall be instituted when 5 consecutive lots or batches have been considered acceptable on original inspection.

A10.3.3 Normal to Reduced. When normal inspection is in effect, reduced inspection shall be instituted providing that all of the following conditions are satisfied:

a. The preceding 10 lots or batches have been on normal inspection and none has been rejected; and
b. Production is at a steady rate; and
c. Reduced inspection is considered desirable by the responsible authority and is permitted by the contract or specification.

A10.3.4 Reduced to Normal. When reduced inspection is in effect, normal inspection shall be instituted if any of the following occur on original inspection:

a. A lot or batch is rejected; or
b. Production becomes irregular or delayed; or
c. Other conditions warrant that normal inspection shall be instituted.

A10.4 Discontinuation of Inspection. In the event that 10 consecutive lots or batches remain on tightened inspection (or such other number as may be designated by the responsible authority), inspection under the provisions of this document should be discontinued pending action to improve the quality of submitted material.

TABLE A-1
AQL Conversion Table

For specified AQL values falling within these ranges.	Use this AQL value
– to 0.109	0.10
0.110 to 0.164	0.15
0.165 to 0.279	0.25
0.280 to 0.439	0.40
0.440 to 0.669	0.65
0.700 to 1.09	1.0
1.10 to 1.64	1.5
1.65 to 2.79	2.5
2.80 to 4.39	4.0
4.40 to 6.99	6.5
7.00 to 10.9	10.0

TABLE A-2[2]
Sample Size Code Letters[1]

Lot Size	Inspection Levels	
	Special	General
	S3 S4	I II III
2 to 8	B B	B B C
9 to 15	B B	B B D
16 to 25	B B	B C E
26 to 50	B B	C D F
51 to 90	B B	D E G
91 to 150	B C	E F H
151 to 280	B D	F G I
281 to 400	C E	G H J
401 to 500	C E	G I J
501 to 1,200	D F	H J K
1,201 to 3,200	E G	I K L
3,201 to 10,000	F H	J L M
10,001 to 35,000	G I	K M N
35,001 to 150,000	H J	L N P
150,001 to 500,000	H K	M P P
500,001 and over	H K	N P P

[1] Sample size code letters given in body of table are applicable when the indicated inspection levels are to be used.

[2] The theory governing inspection by variables depends on the properties of the normal distribution and, therefore, this method of inspection is only applicable when there is reason to believe that the frequency distribution is normal.

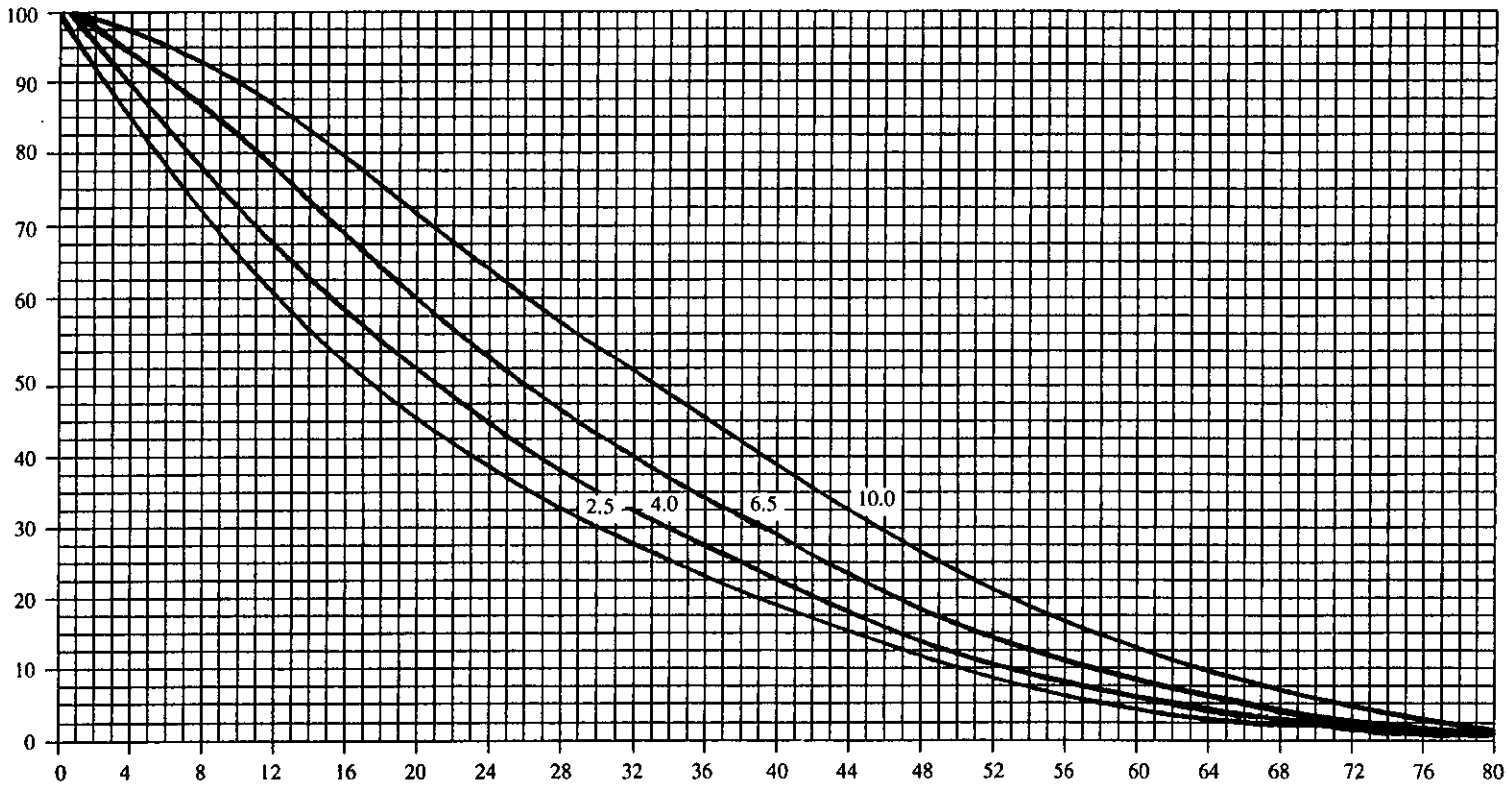
TABLE A-3
Operating Characteristic Curves for Sampling Plans of Sections B, C, and D

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter B

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

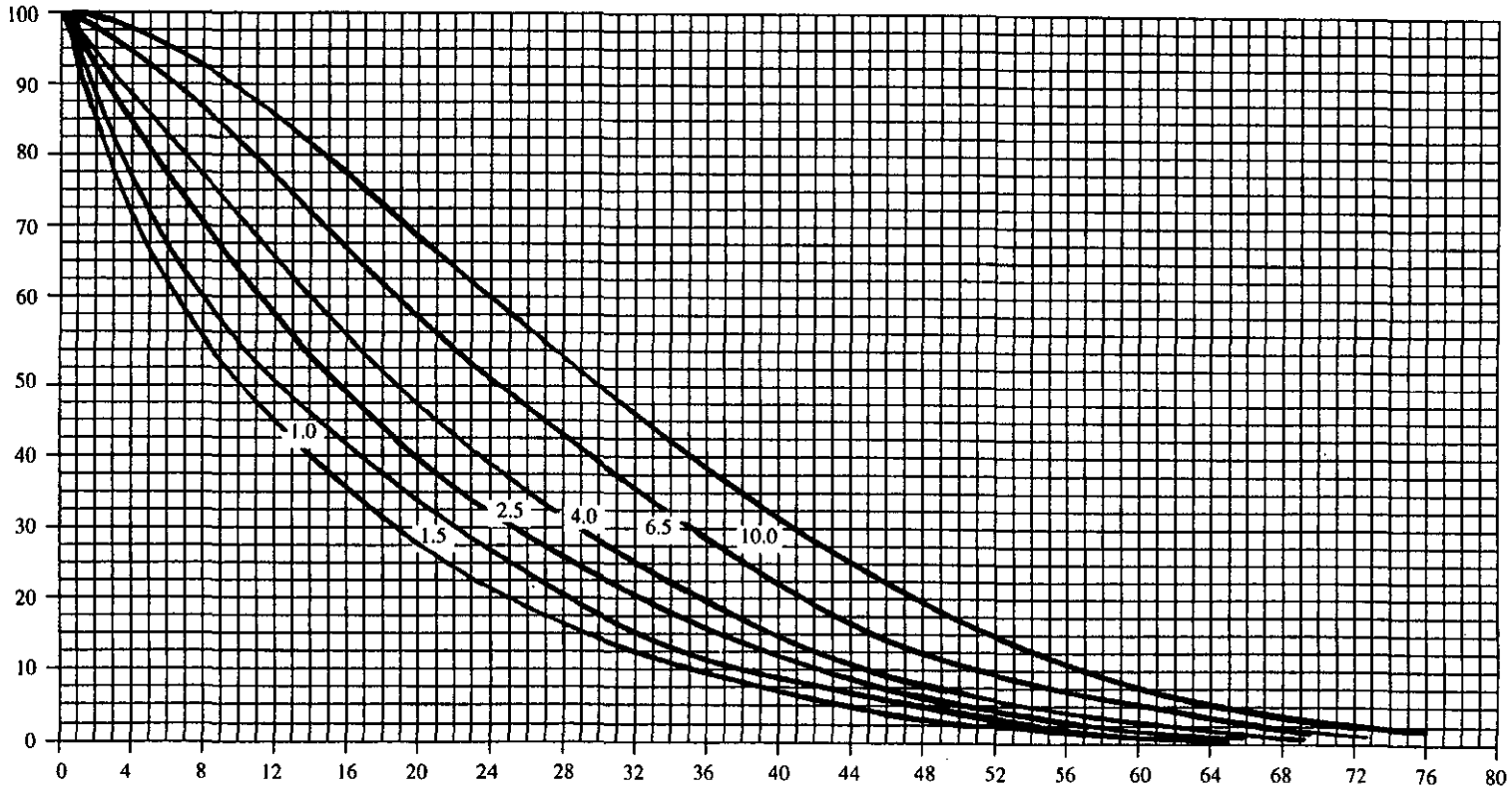
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter C

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

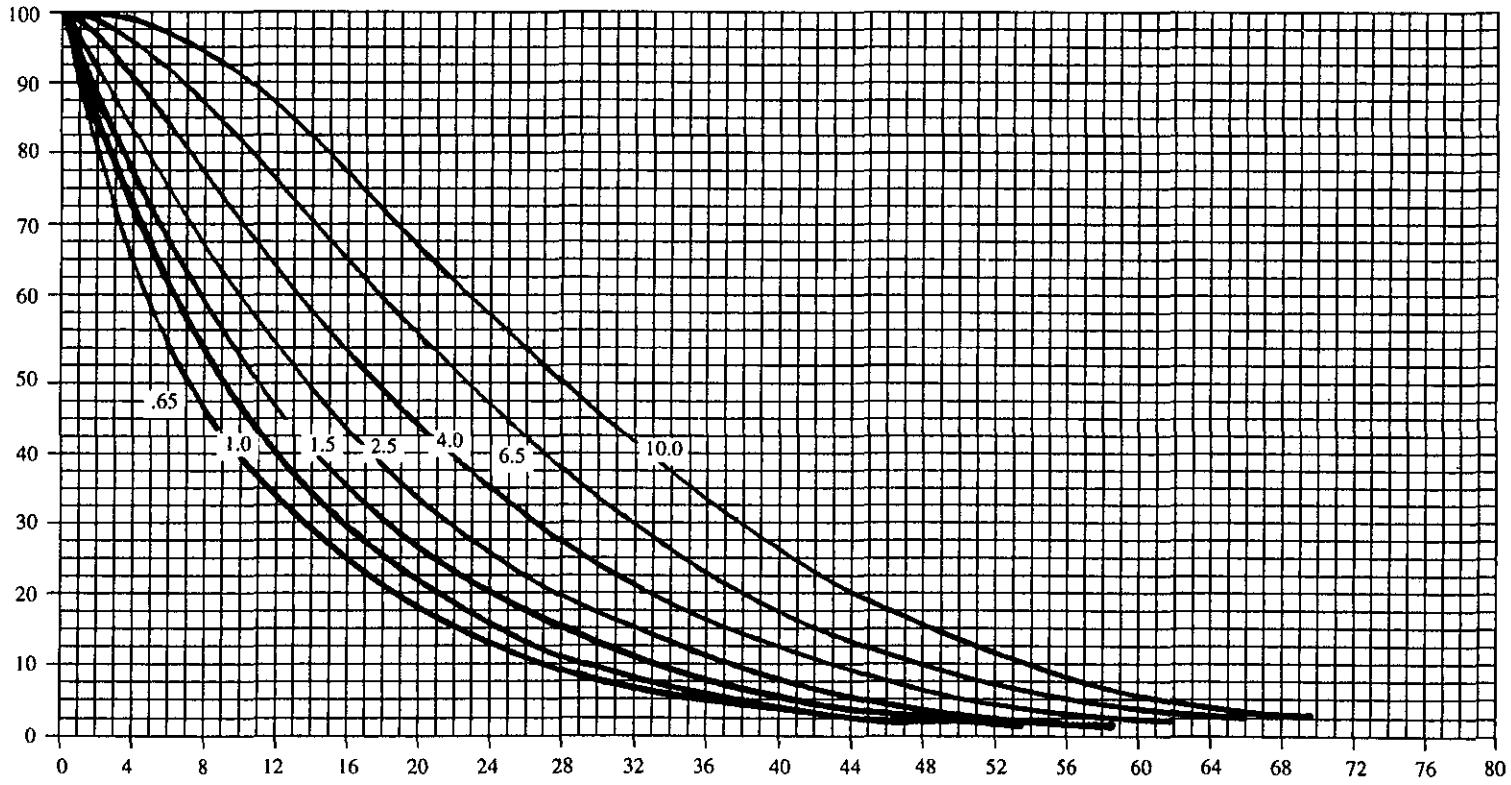
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter D

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

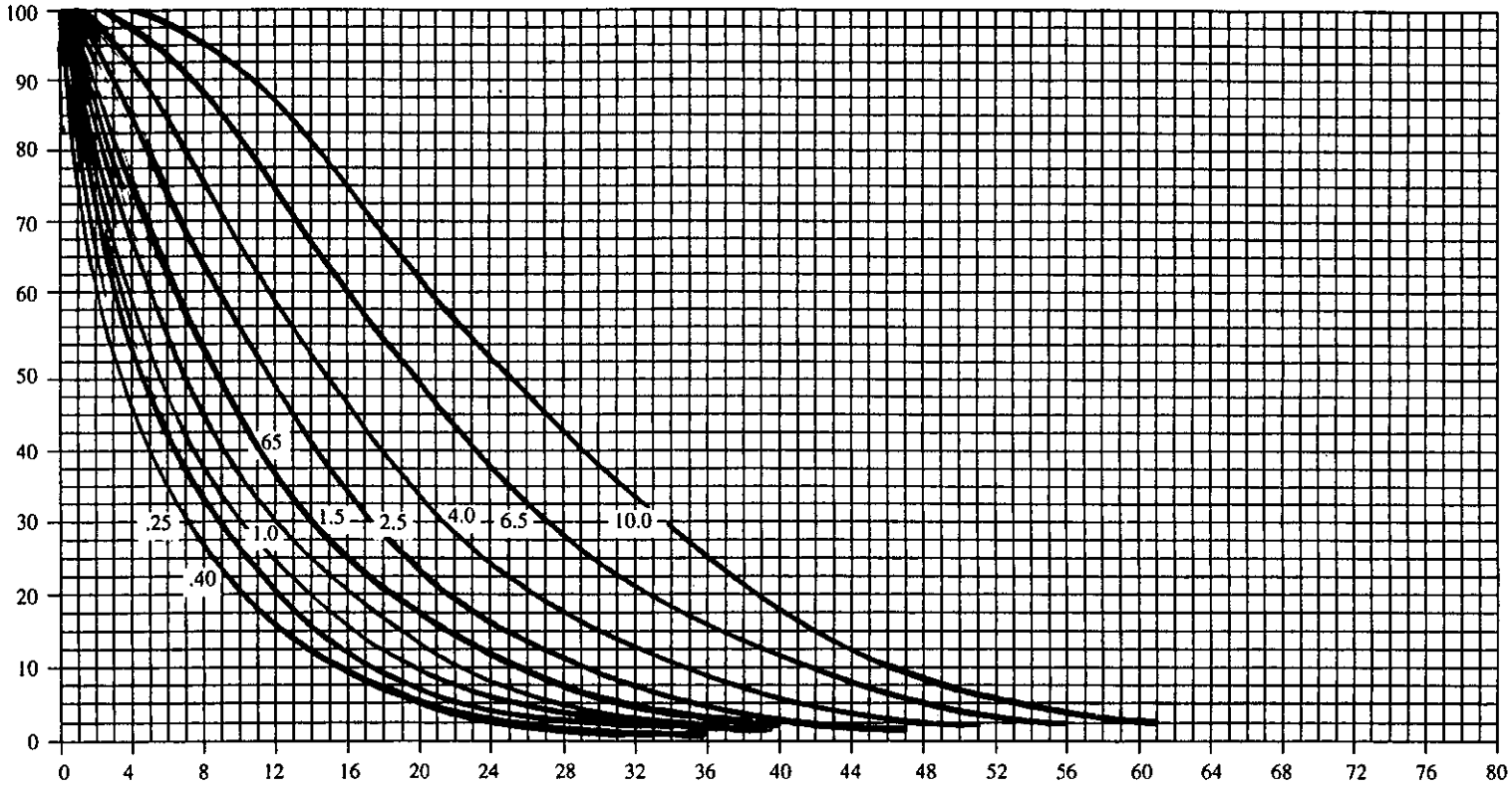
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter E

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

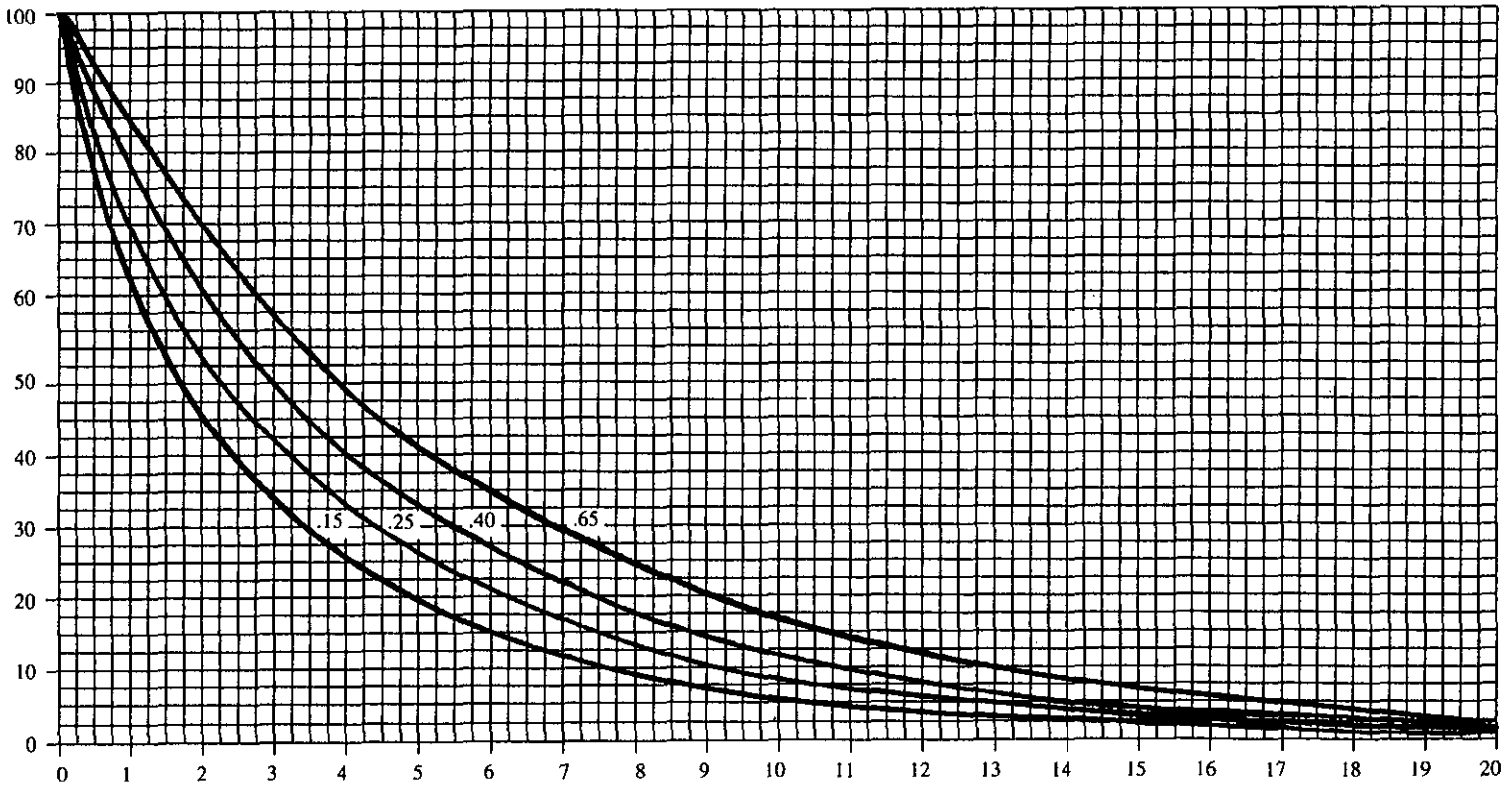
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter F

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

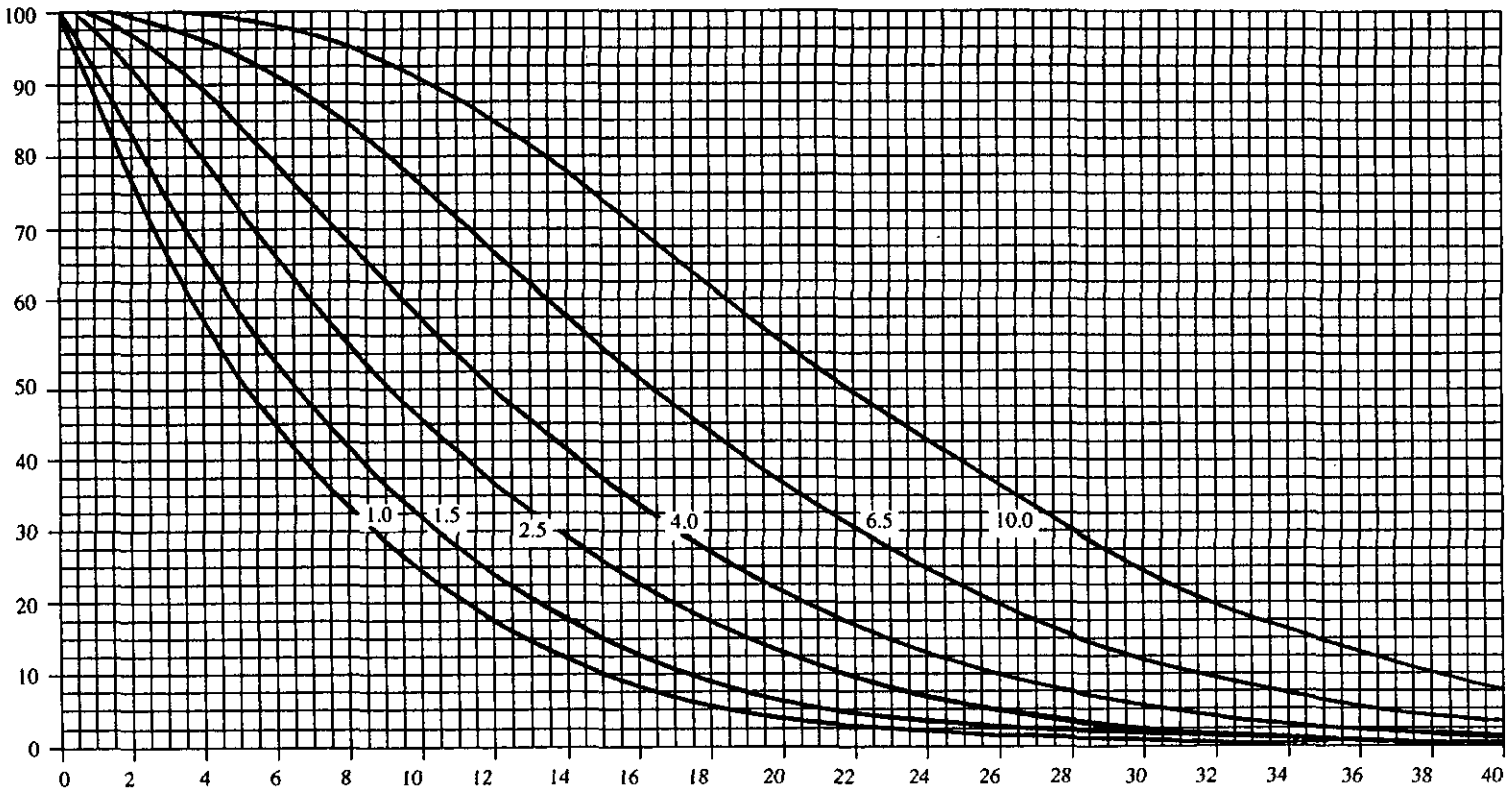
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter F (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

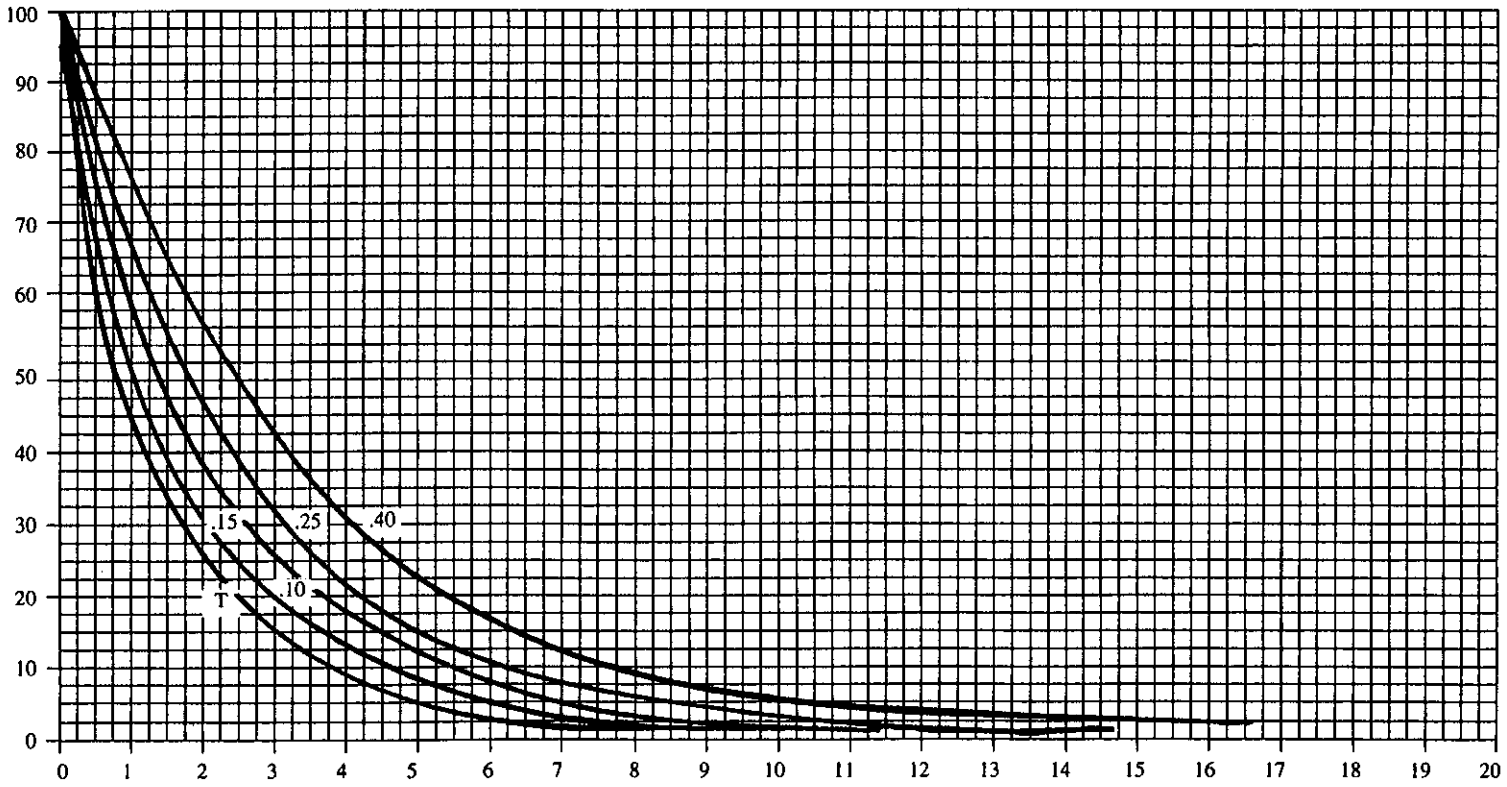
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter G

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

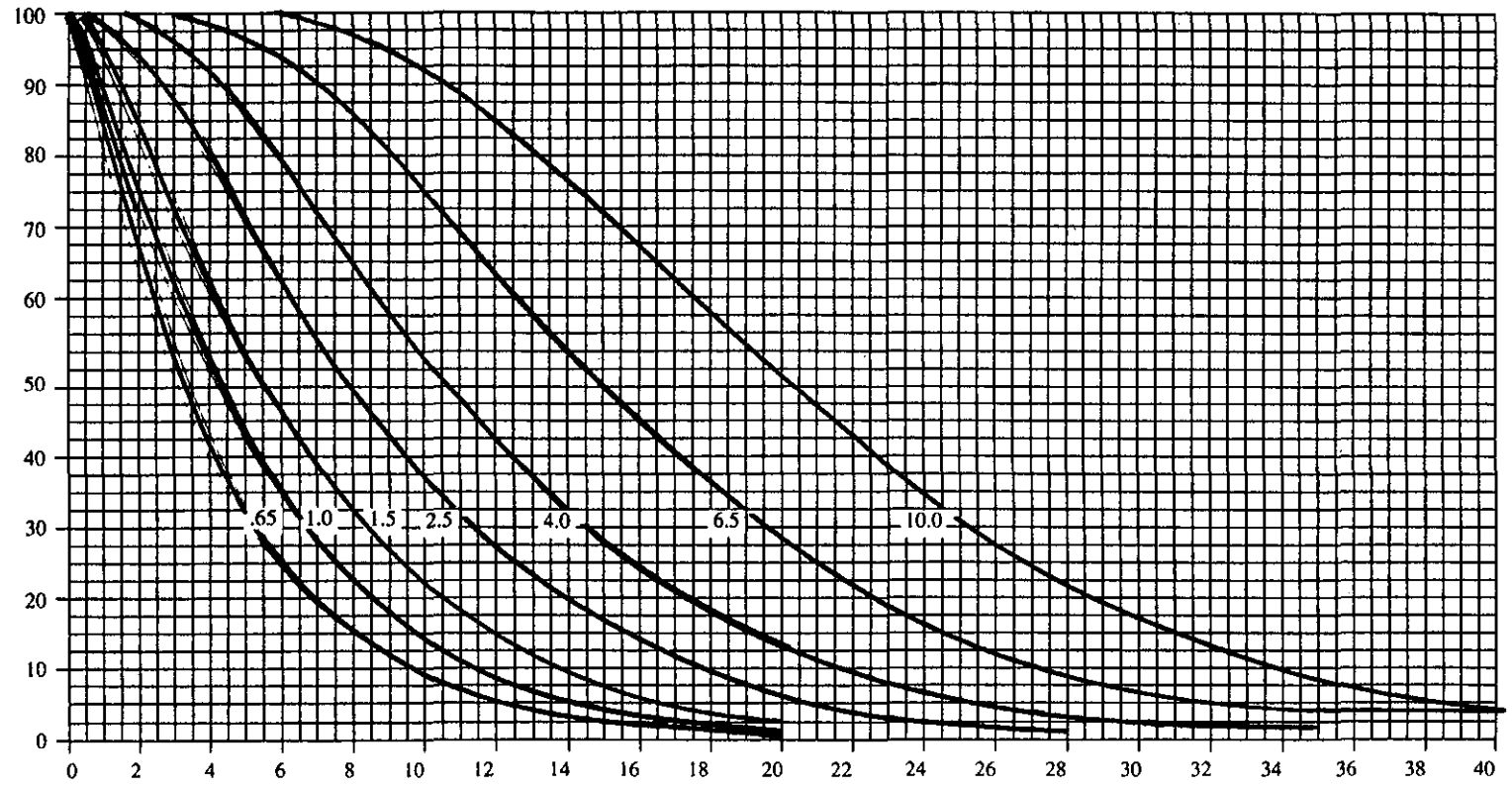
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.
T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter G (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

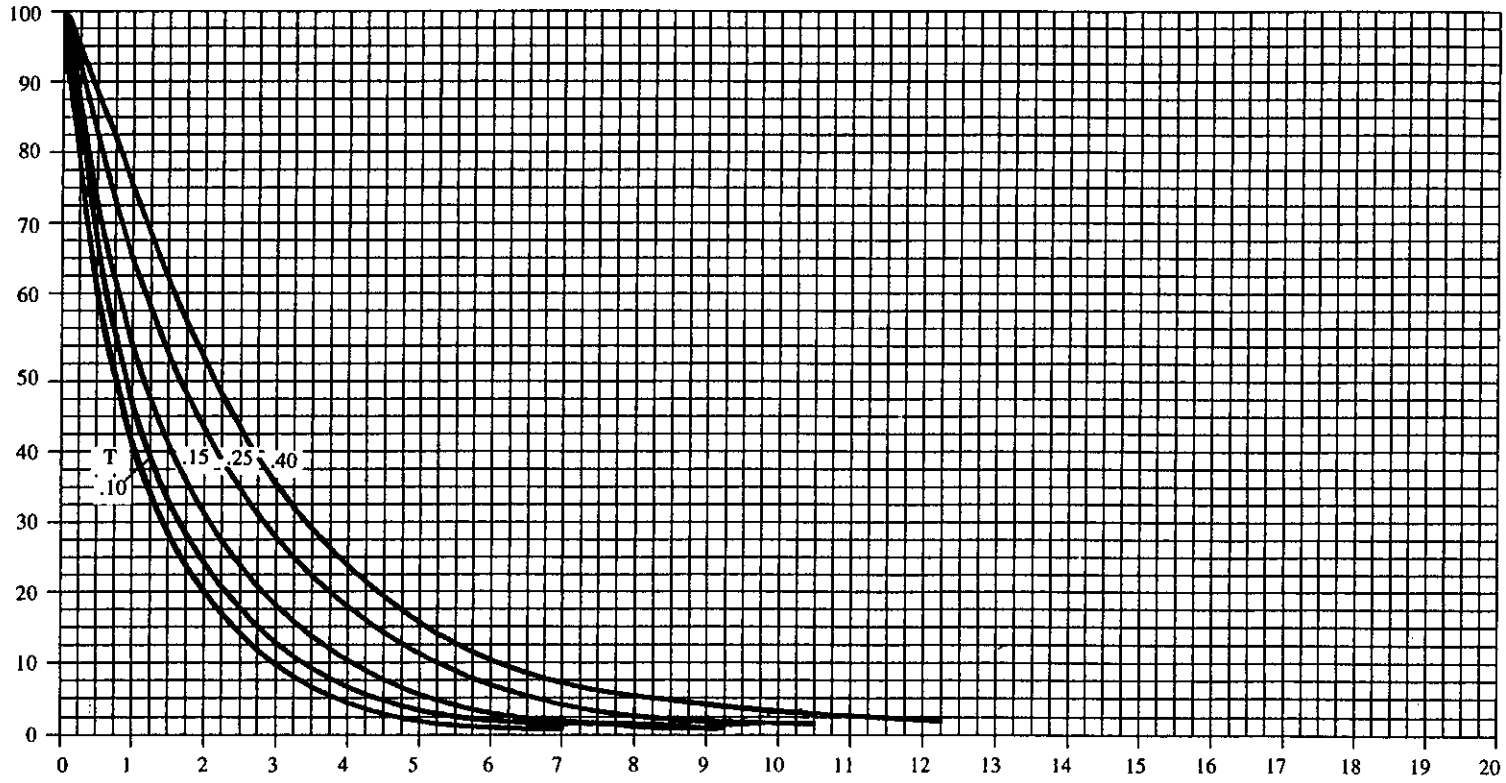
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter H

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

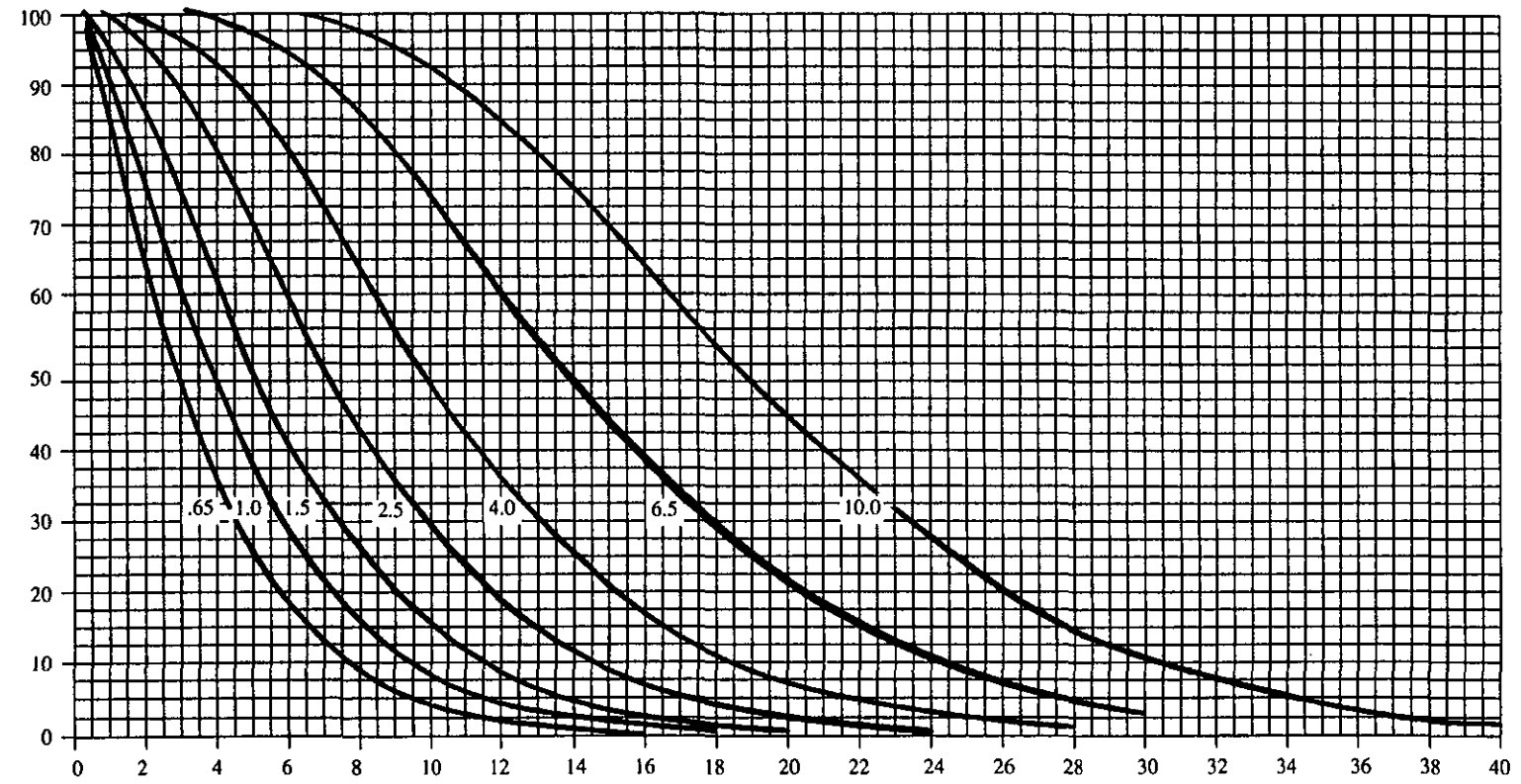
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter H (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

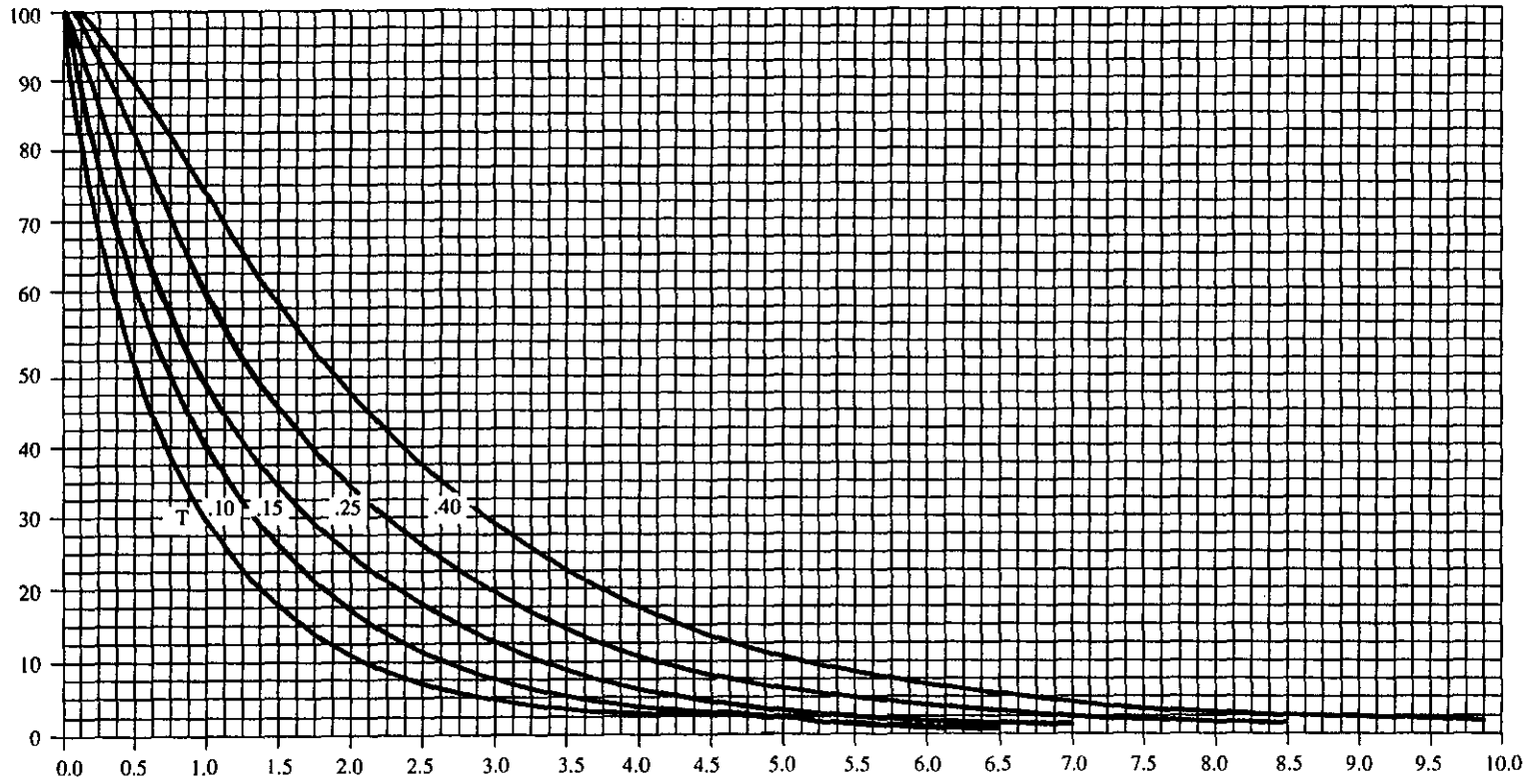
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter I

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

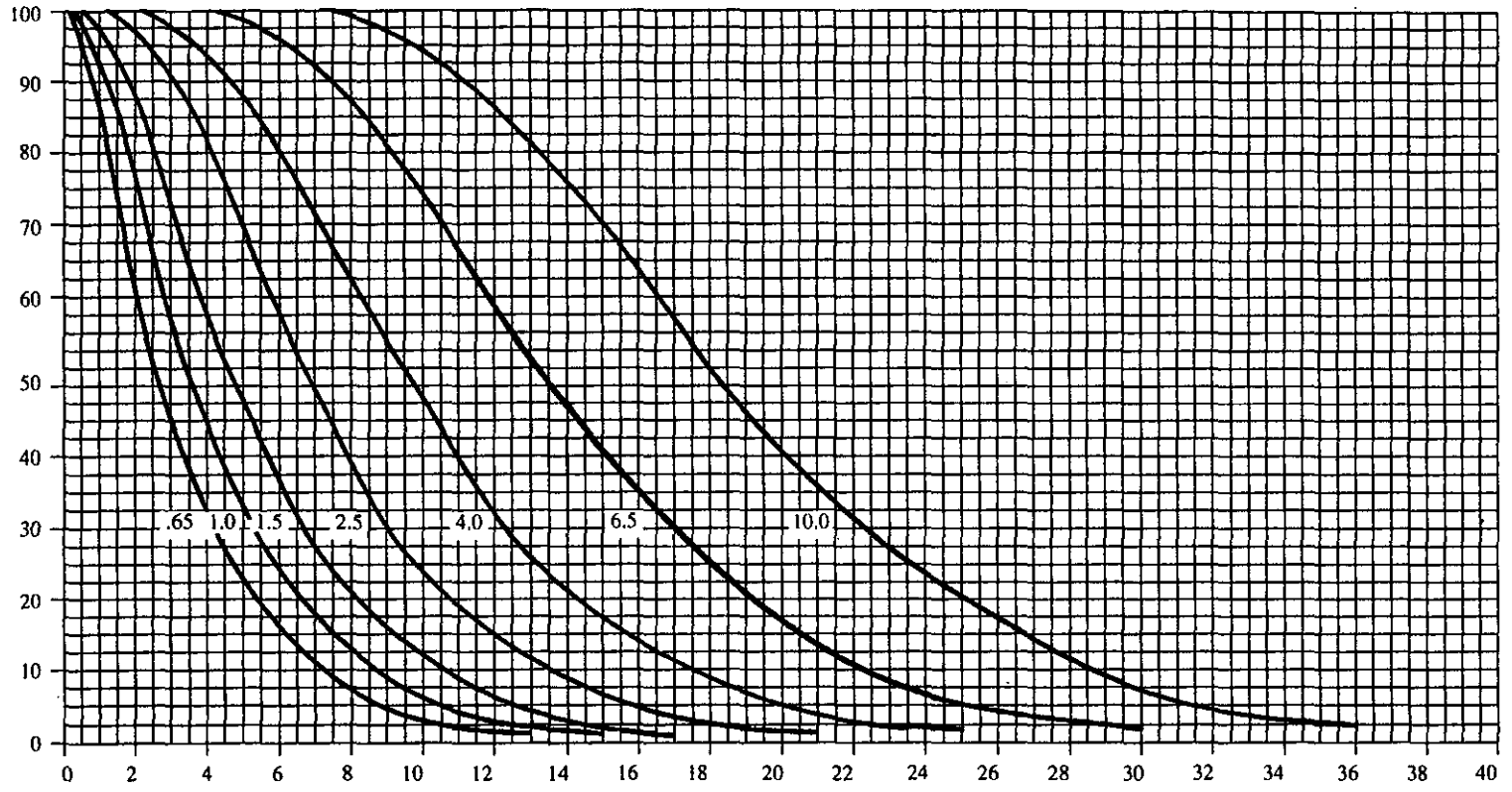
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter I (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

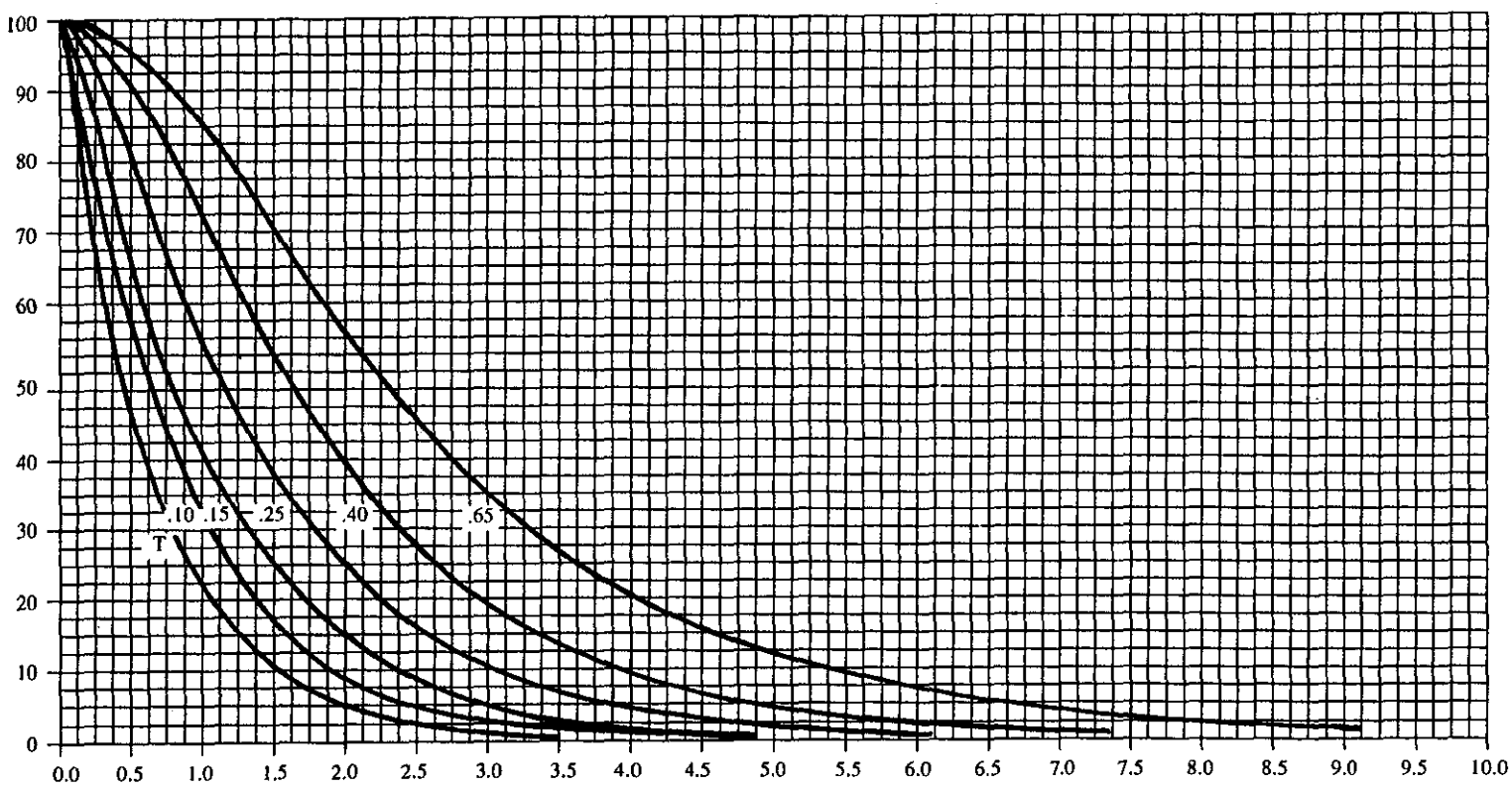
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter J

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

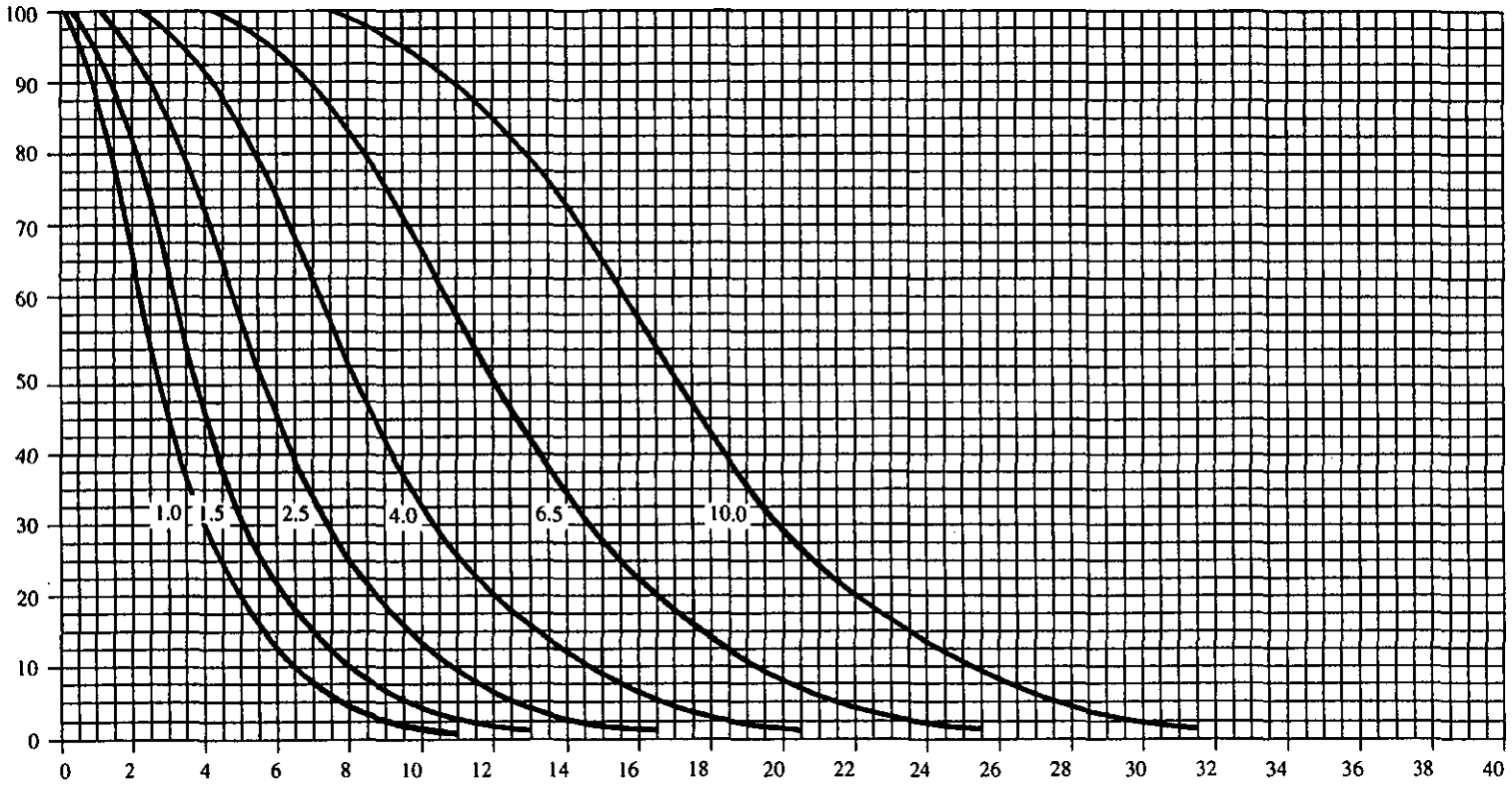
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter J (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

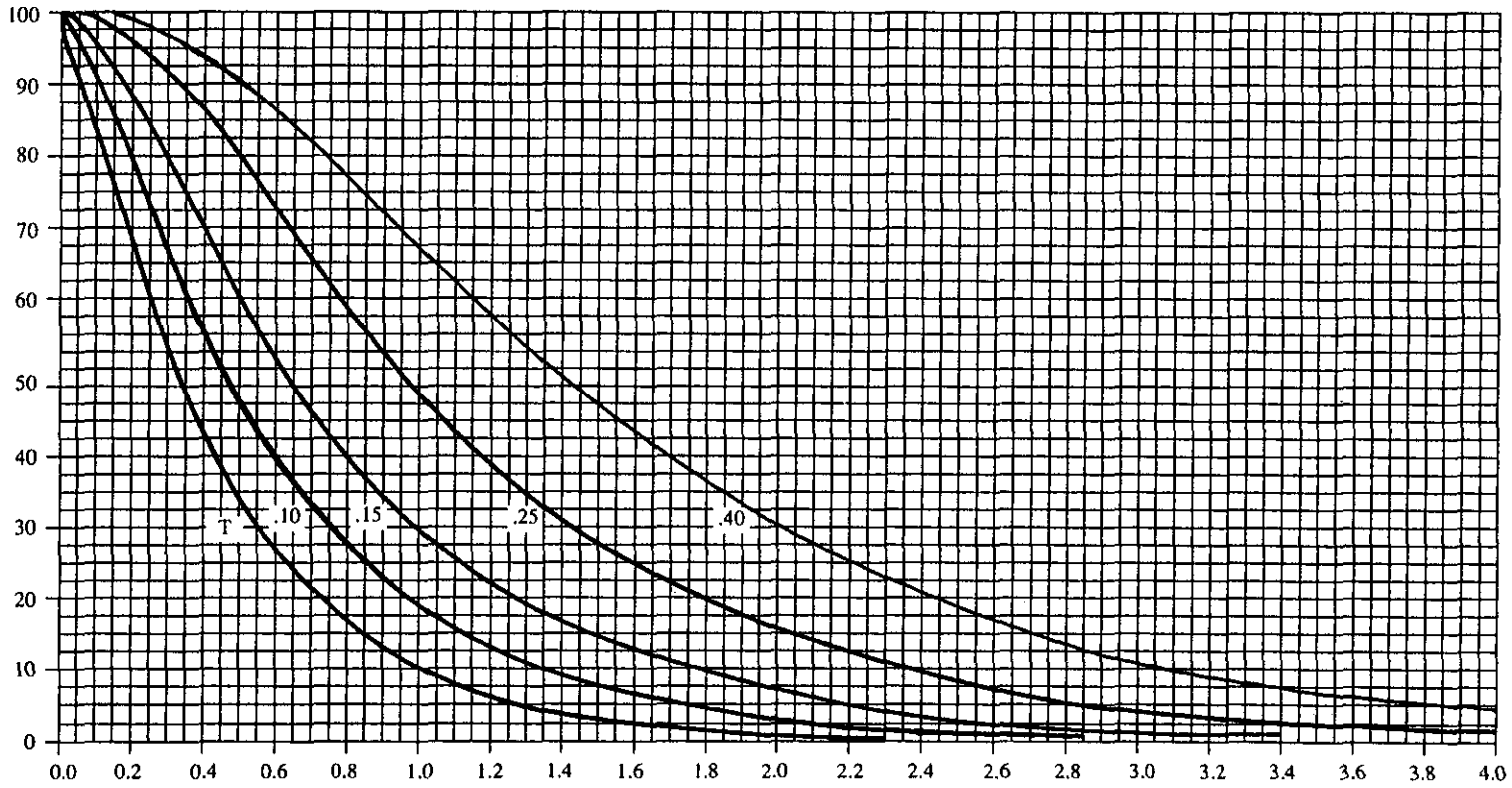
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter K

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

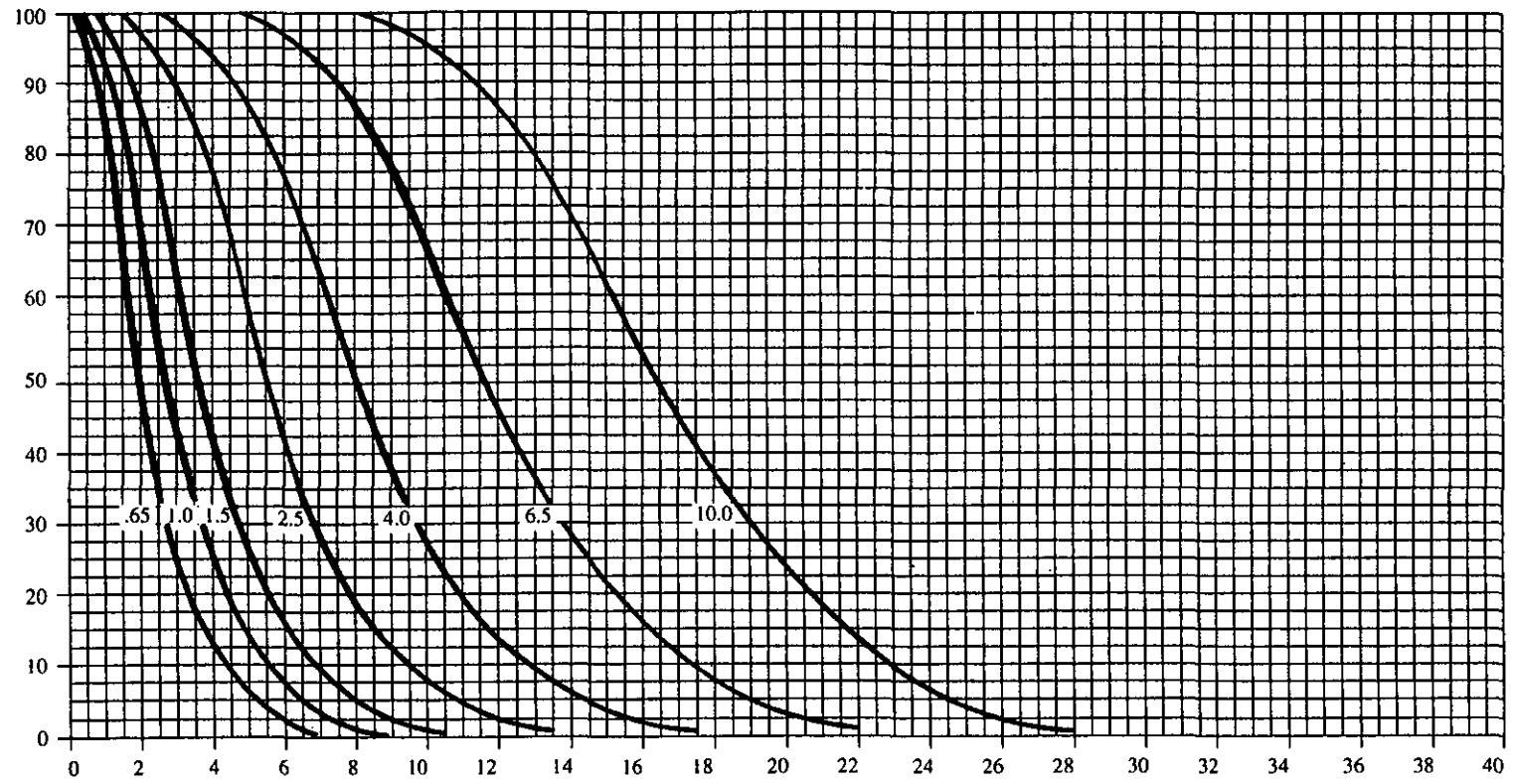
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter K (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

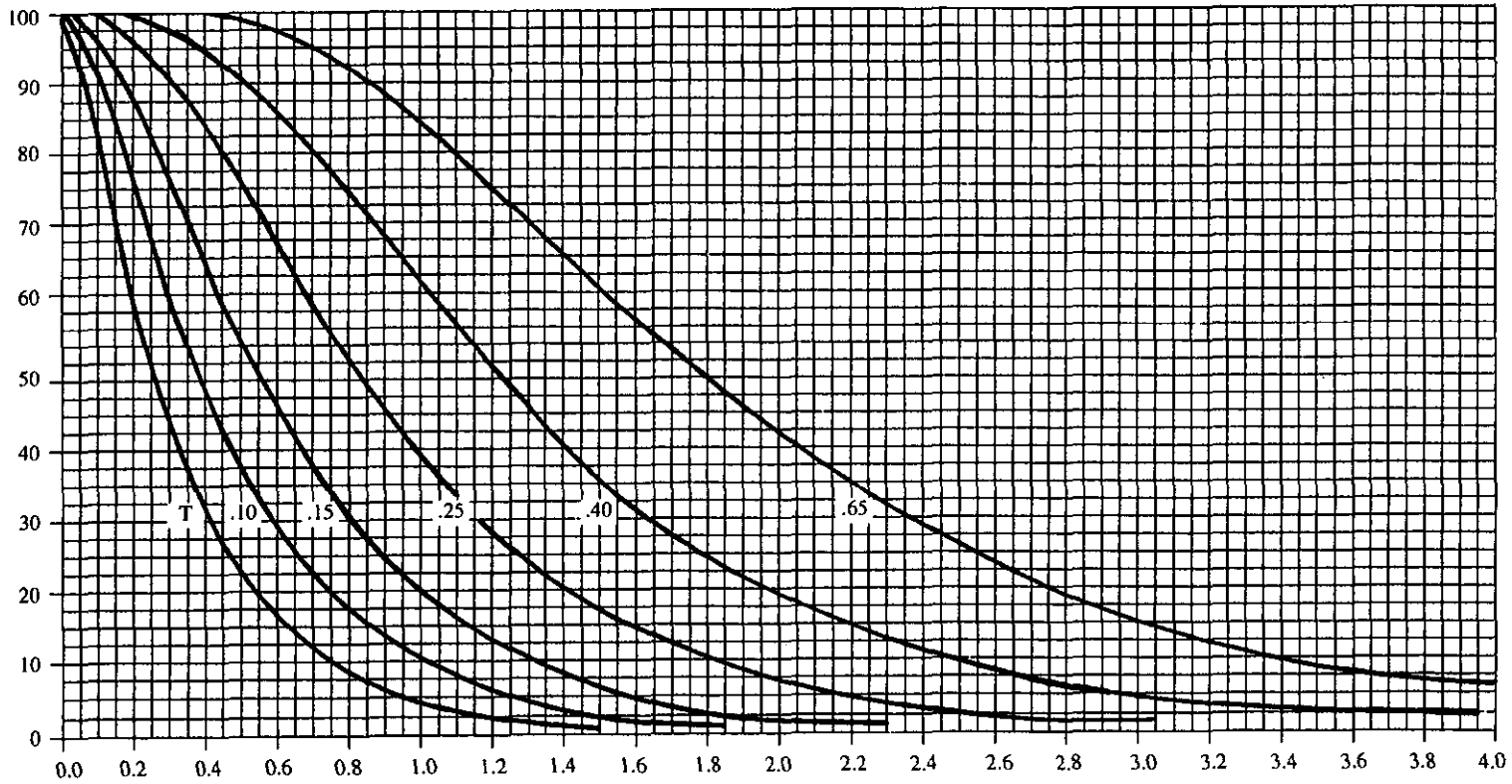
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter L

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

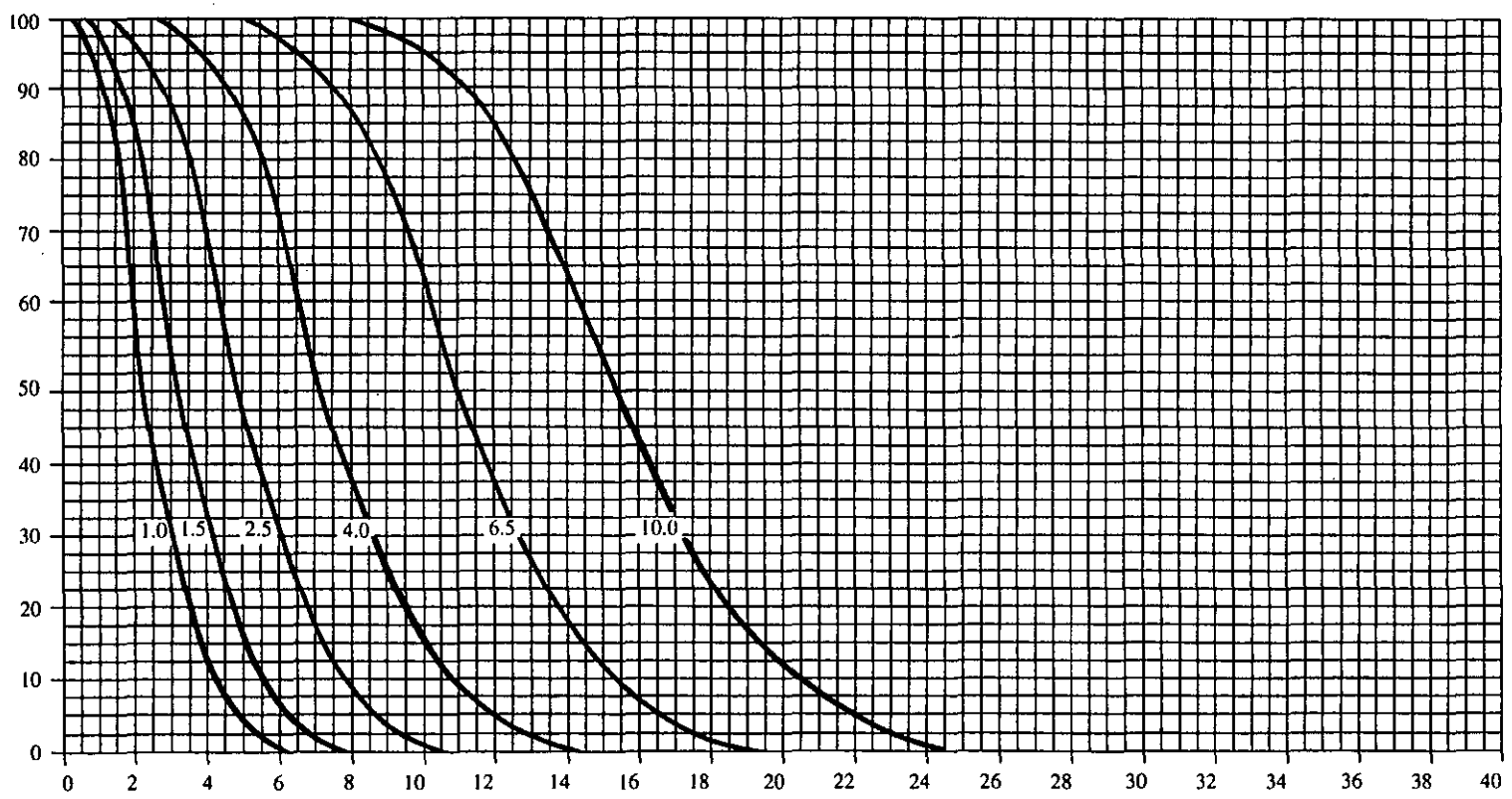
QUALITY OF SUBMITTED LOTS (In percent nonconforming)

NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter L (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

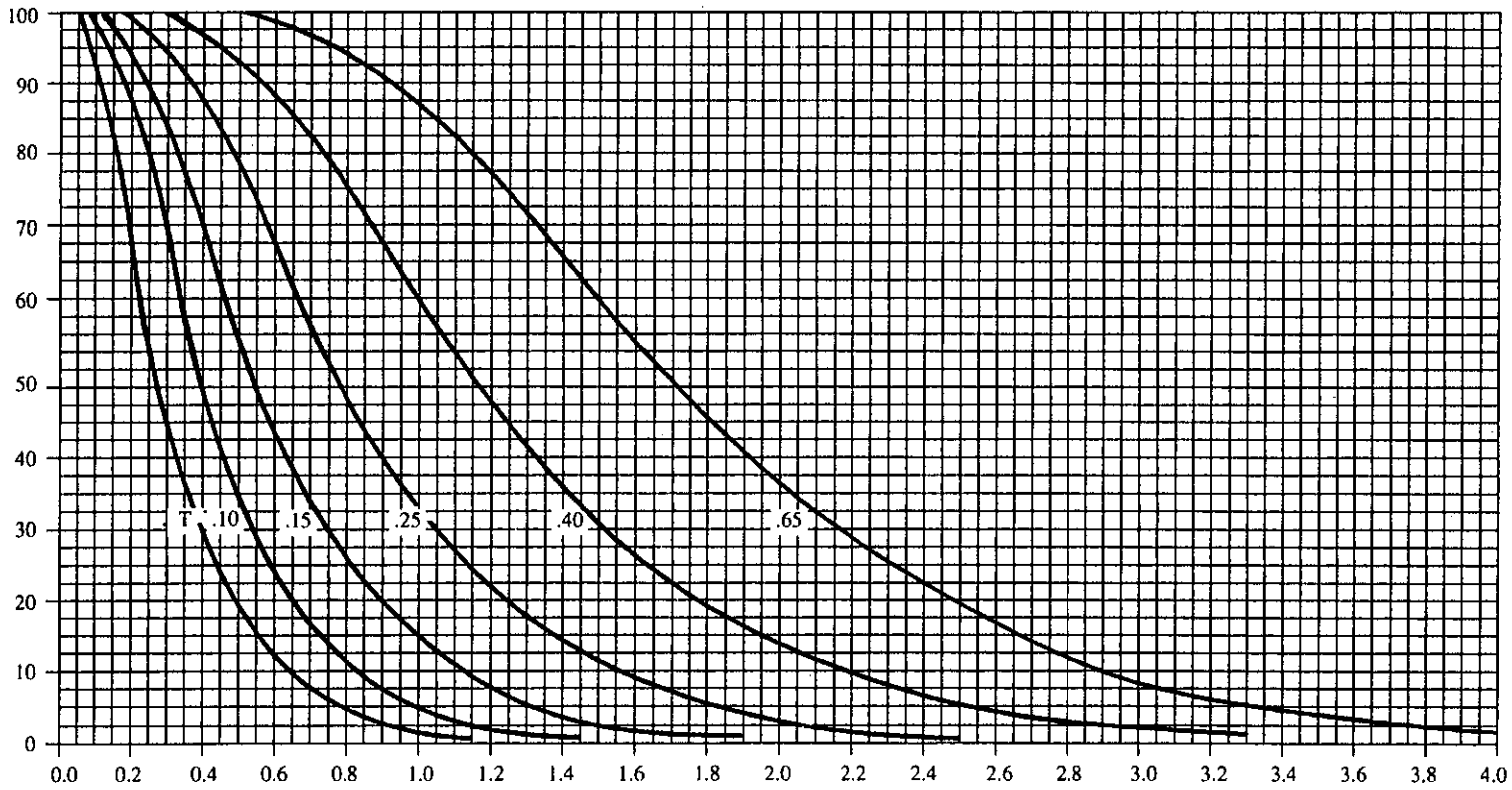
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter M

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

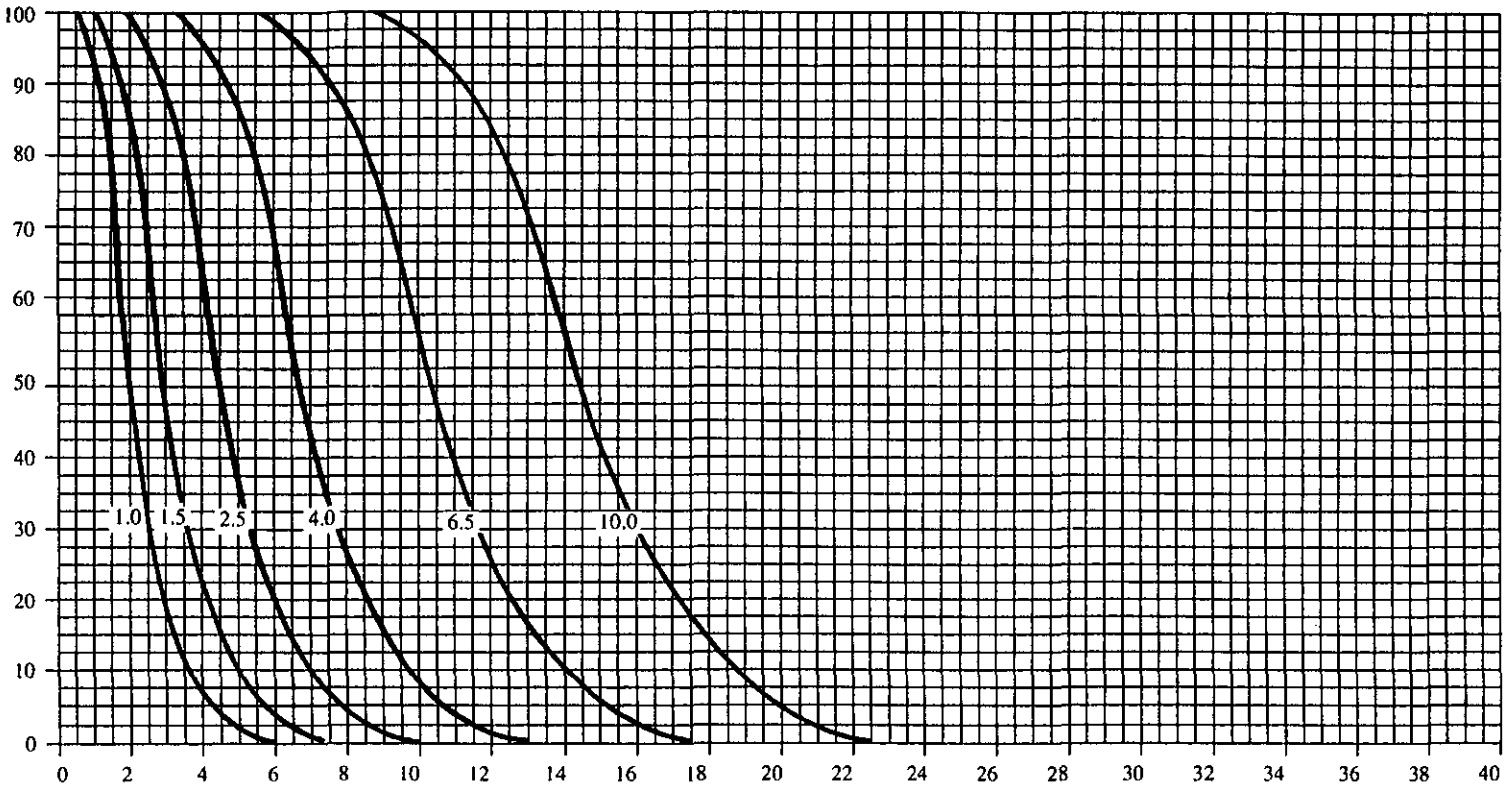
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter M (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

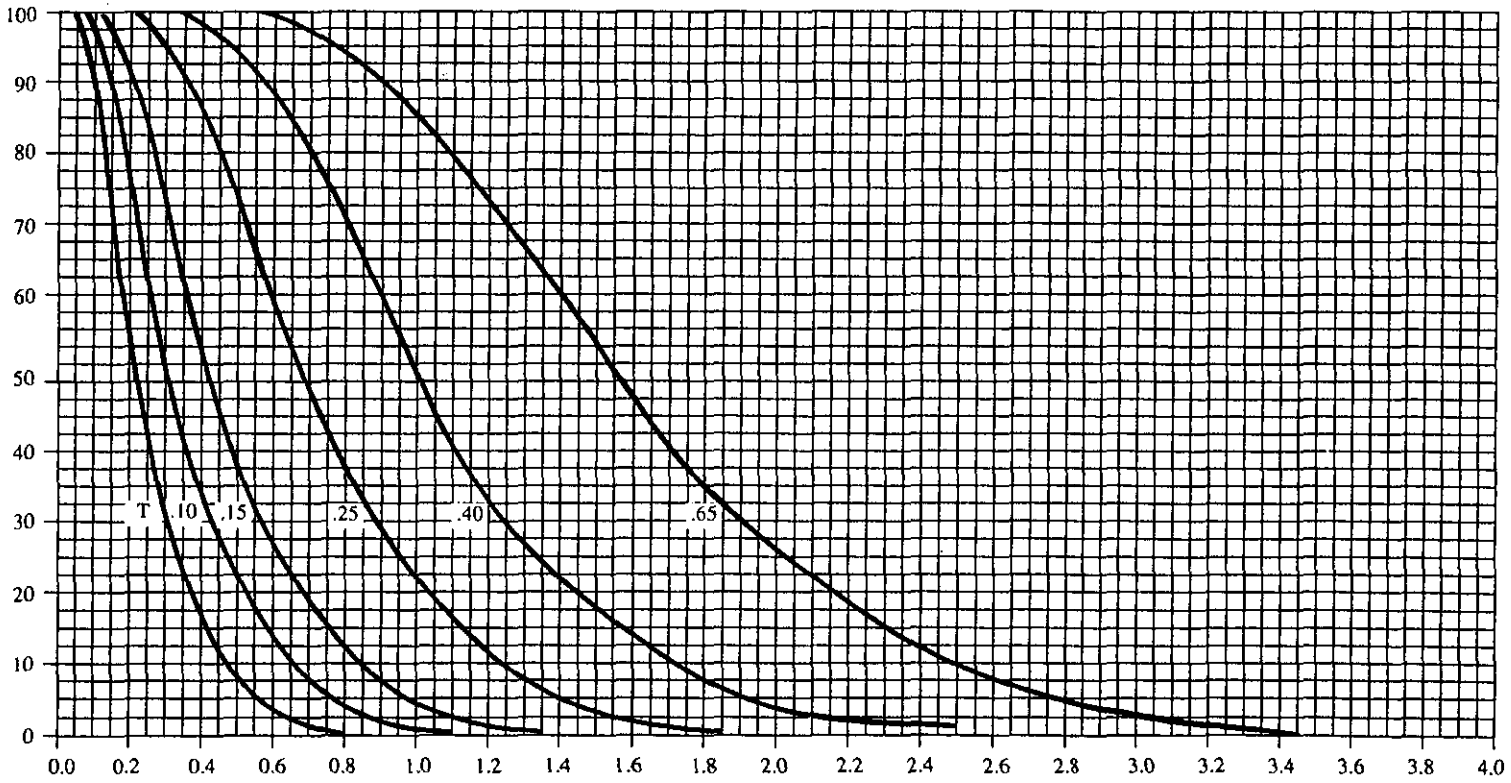
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter N

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

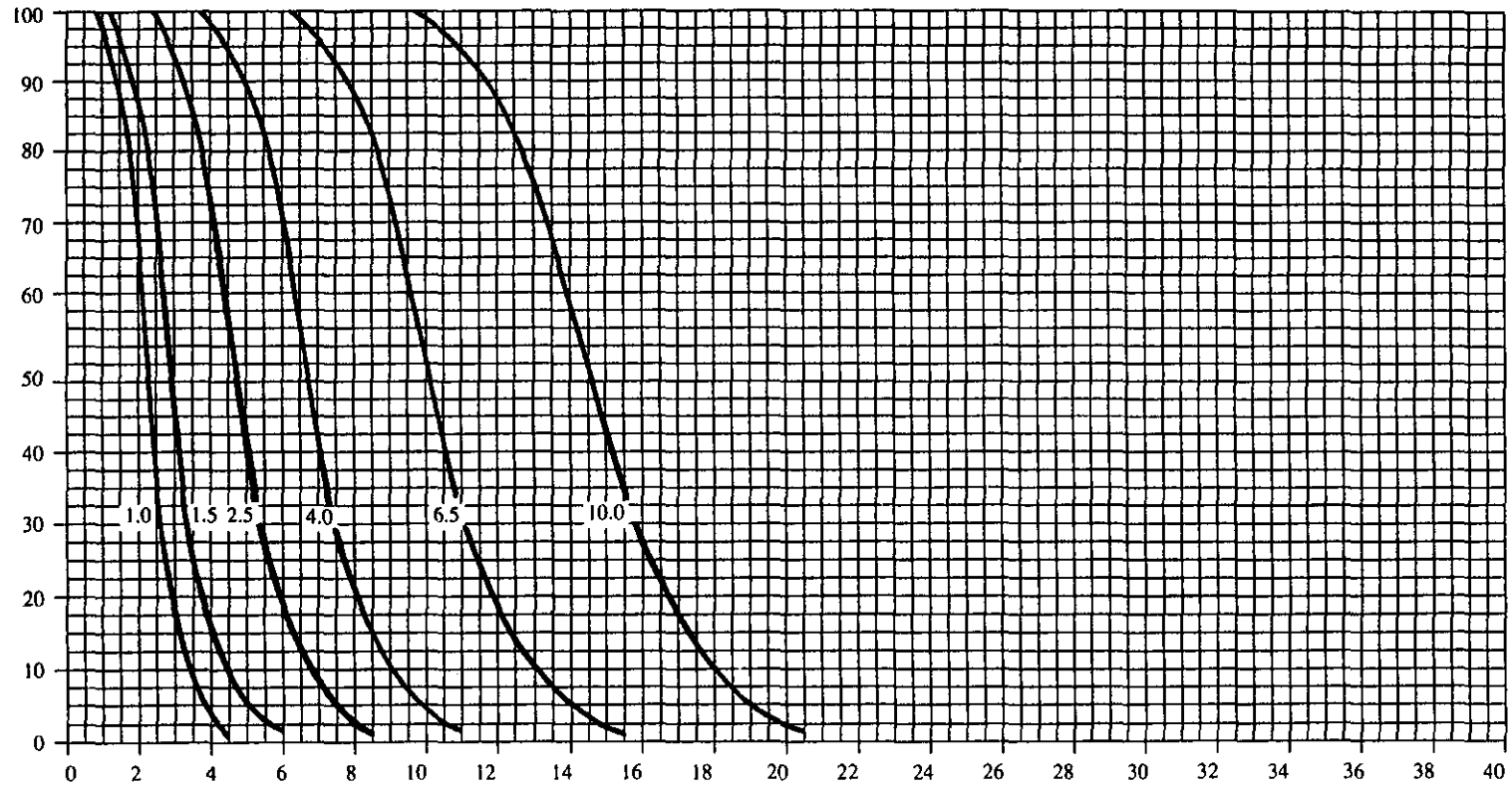
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter N (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

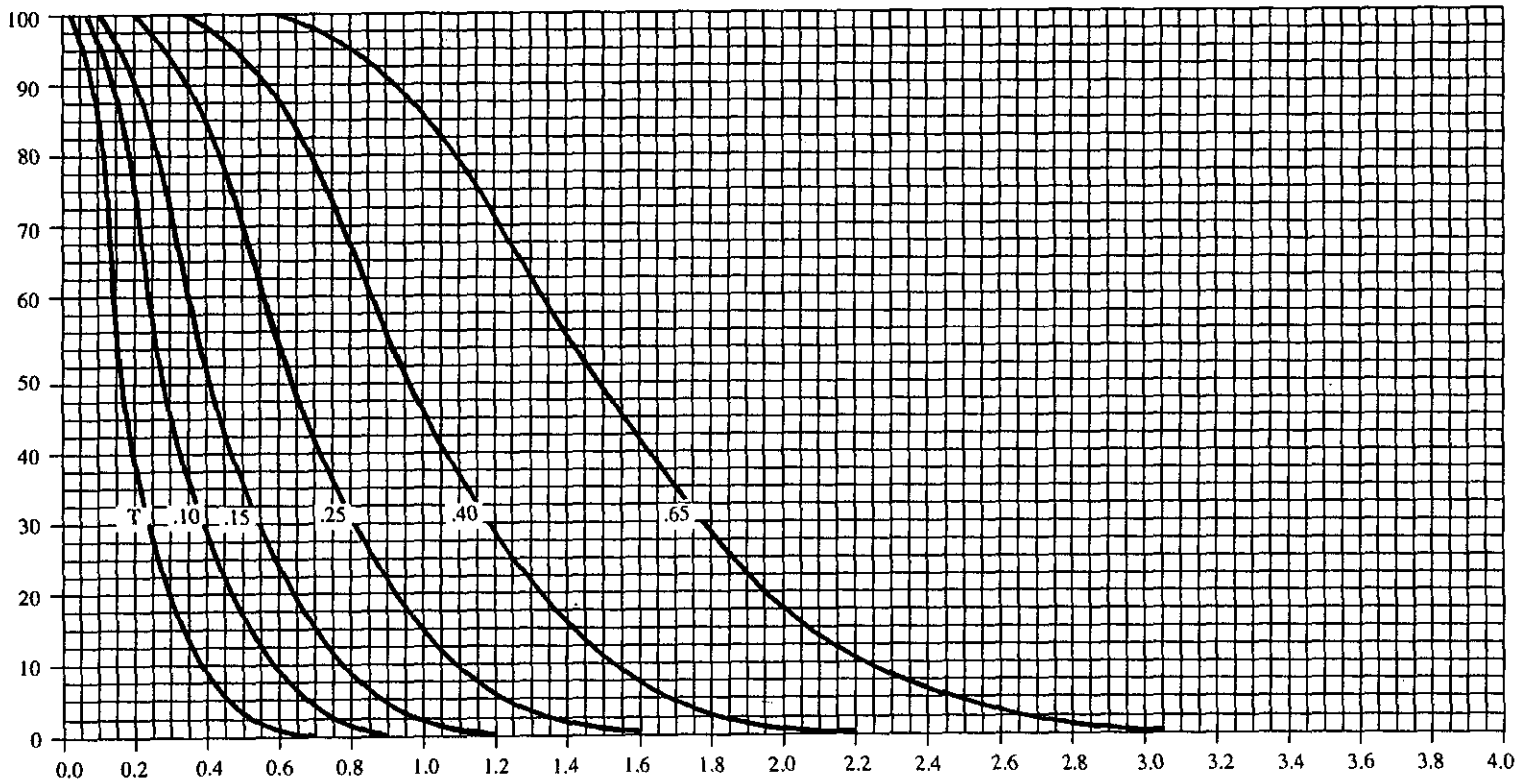
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method
Sample Size Code Letter P

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

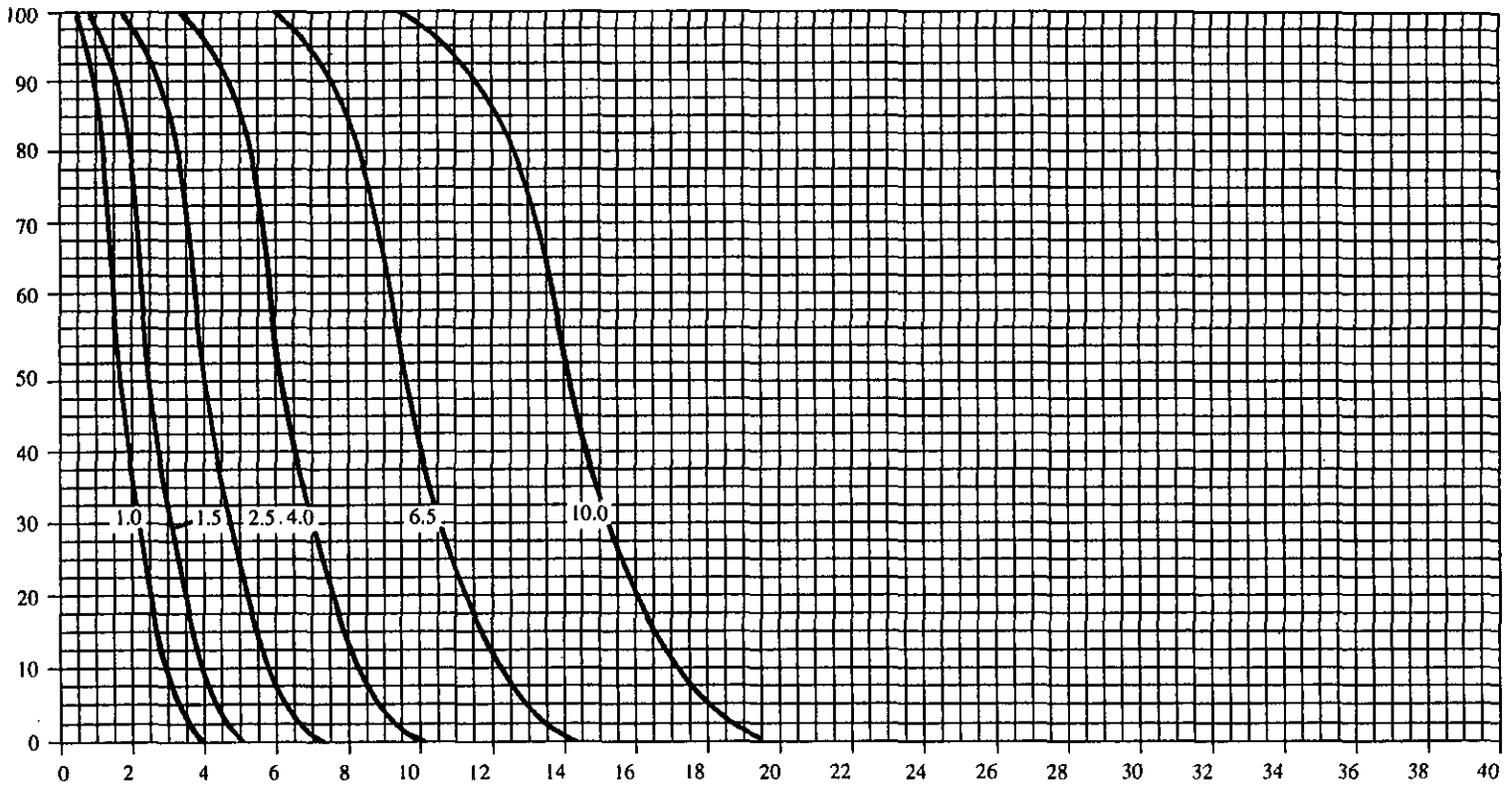
NOTE: Figures on curves are Acceptable Quality Levels for normal inspection. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

Table A-3

Operating Characteristic Curves for Sampling Plans Based on Standard Deviation Method Sample Size Code Letter P (Continued)

(Curves for sampling plans based on range method and known variability are essentially equivalent)

PERCENT OF LOTS EXPECTED TO BE ACCEPTED



The values of the percent of lots expected to be accepted are valid only when measurements are selected at random from a normal distribution.

QUALITY OF SUBMITTED LOTS (In percent nonconforming)

NOTE: Figures on curves are Acceptable Quality Levels for normal inspection.

SECTION B
VARIABILITY UNKNOWN—STANDARD DEVIATION METHOD

Part 1
SINGLE SPECIFICATION LIMIT

B1. SAMPLING PLAN FOR SINGLE SPECIFICATION LIMIT

This part of the Standard describes the procedures for use with plans for a single specification limit when variability of the lot with respect to the quality characteristic is unknown and the standard deviation method is used. The acceptability criterion is given in two equivalent forms. These are identified as Form 1 and Form 2.

B1.1 Use of Sampling Plans. To determine whether the lot meets the acceptability criterion with respect to a particular quality characteristic and AQL value, the applicable sampling plan shall be used in accordance with the provisions of Section A, General Description of Sampling Plans, and those in this part of the Standard.

B1.2 Drawing of Samples. All samples shall be drawn in accordance with paragraph A7.2.

B1.3 Determination of Sample Size Code Letter. The sample size code letter shall be selected from Table A-2 in accordance with paragraph A7.1.

B2. SELECTING THE SAMPLING PLAN WHEN FORM 1 IS USED

B2.1 Master Sampling Tables. The master sampling tables for plans based on variability unknown for a single specification limit when using the standard deviation method are Tables B-1 and B-2. Table B-1 is used for normal and tightened inspection and Table B-2 for reduced inspection.

B2.2 Obtaining the Sampling Plan. The sampling plan consists of a sample size and an associated acceptability constant.[1] The sampling plan is obtained from Master Table B-1 or B-2.

B2.2.1 Sample Size. The sample size n is shown in the master table corresponding to each sample size code letter.

B2.2.2 Acceptability Constant. The acceptability constant k, corresponding to the sample size mentioned in paragraph B2.2.1, is indicated in the column of the master table corresponding to the applicable AQL value. Table B-1 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table B-2.

B3. LOT-BY-LOT ACCEPTABILITY PROCEDURES WHEN FORM 1 IS USED[2]

B3.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a single specification limit shall be judged by the quantity $(U - \bar{X})/s$ or $(\bar{X} - L)/s$.

B3.2 Computation. The following quantity shall be computed: $(U - \bar{X})/s$ or $(\bar{X} - L)/s$, depending on whether the specification limit is an upper or lower limit, where

U is the upper specification limit,
L is the lower specification limit,
$\bar{X}$ is the sample mean, and
s is the estimate of lot standard deviation.

B3.3 Acceptability Criteria. Compare the quantity $(U - \bar{X})/s$ or $(\bar{X} - L)/s$ with the acceptability constant k. If $(U - \bar{X})/s$ or $(\bar{X} - L)/s$ is equal to or greater than k, the lot meets the acceptability criterion; if $(U - \bar{X})/s$ or $(\bar{X} - L)/s$ is less than k or negative, then the lot does not meet the acceptability criterion.

B4. SUMMARY FOR OPERATION OF SAMPLING PLAN WHEN FORM 1 IS USED

The following steps summarize the procedures to be followed:

(1) Determine the sample size code letter from Table A-2 by using the lot size and inspection level.

(2) Obtain plan from Master Table B-1 or B-2 by selecting the sample size n and the acceptability constant k.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic for each unit of the sample.

(4) Compute the sample mean $(\bar{X})$ and estimate of lot standard deviation s, and also compute the quantity $(U-\bar{X})/s$ for an upper specification limit U or the quantity $(\bar{X} - L)/s$ for a lower specification limit L.

[1]See Appendix B for definitions of all symbols used in the sampling plans based on variability unknown—standard deviation method.
[2]See Example B-1 for a complete example of this procedure.

(5) If the quantity $(U-\bar{X})/s$ or $(\bar{X}-L)/s$ is equal to or greater than k, the lot meets the acceptability criterion; if $(U-\bar{X})/s$ or $(\bar{X}-L)/s$ is less than k or negative, then the lot does not meet the acceptability criterion.

B5. SELECTING THE SAMPLING PLAN WHEN FORM 2 IS USED

B5.1 Master Sampling Tables. The master sampling tables for plans based on variability unknown for a single specification limit when using the standard deviation method are Table B-3 and B-4 of Part II. Table B-3 is used for normal and tightened inspection and Table B-4 for reduced inspection.

B5.2 Obtaining the Sampling Plan. The sampling plan consists of a sample size and an associated maximum allowable percent nonconforming. The sampling plan is obtained from Master Table B-3 or B-4.

B5.2.1 Sample Size. The sample size n is shown in the master table corresponding to each sample size code letter.

B5.2.2 Maximum Allowable Percent Nonconforming. The maximum allowable percent nonconforming M for sample estimates corresponding to the sample size mentioned in paragraph B5.2.1 is indicated in the column of the master table corresponding to the applicable AQL value. Table B-3 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table B-4.

B6. LOT-BY-LOT ACCEPTABILITY PROCEDURES WHEN FORM 2 IS USED[3]

B6.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a single specification limit shall be judged by the percent of nonconforming product outside the upper or lower specification limit. The percentage of nonconforming product is estimated by entering Table B-5 with the quality index and the sample size.

B6.2 Computation of Quality Index. The quality index $Q_U = (U-\bar{X})/s$ shall be computed if the specification limit is an upper limit U, or $Q_L(\bar{X}-L)/s$ if it is a lower limit L. The quantities, $(\bar{X})$ and s, are the sample mean and estimate of lot standard deviation, respectively.

B6.3 Estimate of Percent Nonconforming in Lot. The quality of a lot shall be expressed by p_U, the estimated percent nonconforming in the lot above the upper specification limit, or by p_L, the estimated percent nonconforming below the lower specification limit. The estimated percent nonconforming p_U or p_L is obtained by entering Table B-5 with Q_U or Q_L and the appropriate sample size.

B6.4 Acceptability Criterion. Compare the estimated lot percent nonconforming p_U or p_L with the maximum allowable percent nonconforming M. If p_U or p_L is equal to or less than M, the lot meets the acceptability criterion; if p_U or p_L is greater than M or if Q_U or Q_L is negative, then the lot does not meet the acceptability criterion.

B7. SUMMARY FOR OPERATION OF SAMPLING PLAN WHEN FORM 2 IS USED

The following steps summarize the procedures to be followed:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Obtain plan from Master Table B-3 or B-4 by selecting the sample size n and the maximum allowable percent nonconforming M.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit of the sample.

(4) Compute the sample mean $\bar{X}$ and the estimate of lot standard deviation s.

(5) Compute the quality index $Q_U = (U-\bar{X})/s$ if an upper specification limit U is specified, or $Q_L = (\bar{X}-L)/s$ if a lower specification limit L is specified.

(6) Determine the estimated lot percent nonconforming P_U or P_L from Table B-5.

(7) If the estimated lot percent nonconforming P_U or P_L is equal to or less than the maximum allowable percent nonconforming M, the lot meets the acceptability criterion; if P_U or P_L is greater than M or if Q_U or Q_L is negative, then the lot does not meet the acceptability criterion.

[3]See Example B-2 for a complete example of this procedure.

EXAMPLE B-1

Example of Calculations

Single Specification Limit—Form 1

Variability Unknown—Standard Deviation Method

Example The maximum temperature of operation for a certain device is specified as 209°F. A lot of 40 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1% is to be used. From Tables A-2 and B-1 it is seen that a sample of size 5 is required. Suppose the measurements obtained are as follows: 197°, 188°, 184°, 205°, and 201°; and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	5	
2	Sum of Measurements: ΣX	975	
3	Sum of Squared Measurements: ΣX^2	190,435	
4	Correction Factor (CF): $\Sigma X^2/n$	190,125	$(975)^2/5$
5	Corrected Sum of Squares (SS): $\Sigma X^2 - CF$	310	190,435 – 190,125
6	Variance (V): $SS/(n-1)$	77.5	310/4
7	Estimate of Lot Standard Deviation s: $\sqrt{V}$	8.81	$\sqrt{77.5}$
8	Sample Mean $\bar{X}$: $\Sigma X/n$	195	975/5
9	Specification Limit (Upper): U	209	
10	The quantity: $(U - \bar{X})/s$	1.59	(209 – 195)/8.81
11	Acceptability Constant: k	1.53	See Table B-1
12	Acceptability Criterion: Compare $(U - \bar{X})/s$ with k	1.59 > 1.53	See Para. B3.3

The lot meets the acceptability criterion, since $(U - \bar{X})/s$ is greater than k.

NOTE: If a single lower specification limit L is given, then compute the quantity $(\bar{X} - L)/s$ in line 10 and compare it with k; the lot meets the acceptability criterion if $(\bar{X} - L)/s$ is equal to or greater than k.

EXAMPLE B-2

Example of Calculations

Single Specification Limit—Form 2

Variability Unknown—Standard Deviation Method

Example The maximum temperature of operation for a certain device is specified as 209° F. A lot of 40 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1% is to be used. From Tables A-2 and B-1 it is seen that a sample of size 5 is required. Suppose the measurements obtained are as follows: 197°, 188°, 184°, 205°, and 201°; and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	5	
2	Sum of Measurements: ΣX	975	
3	Sum of Squared Measurements: ΣX^2	190,435	
4	Correction Factor (CF): $(\Sigma X)^2/n$	190,125	$(975)^2/5$
5	Corrected Sum of Squares (SS): $\Sigma X^2 - CF$	310	190,435 – 190,125
6	Variance (V): $SS/(n-1)$	77.5	310/4
7	Estimate of Lot Standard Deviation s: $\sqrt{V}$	8.81	$\sqrt{77.5}$
8	Sample Mean $\overline{X}$: $\Sigma X/n$	195	975/5
9	Specification Limit (Upper): U	209	
10	Quality Index: $Q_U = (U - \overline{X})/s$	1.59	(209 – 195)/8.81
11	Est. of Lot Percent Ncf.: p_U	2.19%	See Table B-5
12	Max. Allowable Percent Ncf.: M	3.32%	See Table B-3
13	Acceptability Criterion: Compare p_U with M	2.19% < 3.32%	See Para. B6.4

The lot meets the acceptability criterion, since p_U is less than M.

NOTE: If a single lower specification limit L is given, then compute the quality index $Q_L = (\overline{X} - L)/s$ in line 10 and obtain the estimate of lot percent nonconforming p_L. Compare p_L with M; the lot meets the acceptability criterion if p_L is equal to or less than M.

Table B-1 Standard Deviation Method

Master Table for Normal and Tightened Inspection for Plans Based on Variability Unknown
(Single Specification Limit—Form 1)

Sample size code letter	Sample size	Acceptable Quality Levels (normal inspection)											
		T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		k	k	k	k	k	k	k	k	k	k	k	k
B	3	↓	↓	↓	↓	↓	↓	↓	↓	1.12	.958	.765	.566
C	4	↓	↓	↓	↓	↓	↓	1.46	1.34	1.17	1.01	.815	.617
D	5	↓	↓	↓	↓	1.77	1.65	1.52	1.40	1.24	1.07	.874	.675
E	7	↓	2.22	2.13	2.00	1.88	1.75	1.62	1.50	1.33	1.15	.955	.755
F	10	2.44	2.34	2.24	2.11	1.98	1.84	1.72	1.59	1.41	1.23	1.03	.828
G	15	2.53	2.42	2.32	2.19	2.06	1.92	1.79	1.65	1.48	1.30	1.09	.885
H	20	2.58	2.47	2.37	2.23	2.10	1.96	1.83	1.69	1.51	1.33	1.12	.916
I	25	2.61	2.50	2.40	2.26	2.13	1.98	1.85	1.72	1.53	1.35	1.14	.935
J	35	2.66	2.55	2.45	2.31	2.18	2.03	1.89	1.76	1.57	1.39	1.18	.968
K	50	2.71	2.61	2.50	2.36	2.22	2.08	1.94	1.80	1.61	1.42	1.21	1.00
L	75	2.77	2.66	2.55	2.41	2.27	2.12	1.98	1.84	1.65	1.46	1.25	1.03
M	100	2.80	2.69	2.58	2.43	2.29	2.14	2.00	1.86	1.67	1.48	1.26	1.05
N	150	2.84	2.73	2.62	2.47	2.33	2.18	2.03	1.89	1.70	1.51	1.29	1.07
P	200	2.85	2.73	2.62	2.47	2.33	2.18	2.04	1.89	1.70	1.51	1.29	1.08
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00	
		Acceptable Quality Levels (tightened inspection)											

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table B-2 Standard Deviation Method

Master Table for Reduced Inspection for Plans Based on Variability Unknown
(Single Specification Limit—Form 1)

Sample size code letter	Sample size	Acceptable Quality Levels										
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		k	k	k	k	k	k	k	k	k	k	k
B	3	↓	↓	↓	↓	↓	↓	1.12	.958	.765	.566	.341
C	3							1.12	.958	.765	.566	.341
D	3							1.12	.958	.765	.566	.341
E	3					↓	↓	1.12	.958	.765	.566	.341
F	4			↓	↓	1.46	1.34	1.17	1.01	.815	.617	.396
G	5	↓	↓	1.77	1.65	1.52	1.40	1.24	1.07	.874	.675	.456
H	7	2.13	2.00	1.88	1.75	1.62	1.50	1.33	1.15	.955	.755	.536
I	10	2.24	2.11	1.98	1.84	1.71	1.59	1.41	1.23	1.03	.828	.609
J	15	2.32	2.19	2.06	1.92	1.79	1.65	1.48	1.30	1.09	.885	.663
K	20	2.37	2.23	2.10	1.96	1.83	1.69	1.51	1.33	1.12	.916	.694
L	25	2.40	2.26	2.13	1.98	1.85	1.72	1.53	1.35	1.14	.935	.712
M	30	2.41	2.28	2.14	2.00	1.86	1.73	1.55	1.36	1.15	.946	.722
N	50	2.50	2.36	2.22	2.08	1.94	1.80	1.61	1.42	1.21	1.00	.774
P	75	2.55	2.41	2.27	2.12	1.98	1.84	1.65	1.46	1.25	1.03	.806

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Part II
DOUBLE SPECIFICATION LIMIT

B8. SAMPLING PLAN FOR DOUBLE SPECIFICATION LIMIT

This part of the Standard describes the procedures for use with plans for a double specification limit when variability of the lot with respect to the quality characteristic is unknown and the standard deviation method is used.

B8.1 Use of Sampling Plans. To determine whether the lot meets the acceptability criterion with respect to a particular quality characteristic and AQL value(s) the applicable sampling plan shall be used in accordance with the provisions of Section A. General Description of Sampling Plans, and those in this part of the Standard.

B9. SELECTING THE SAMPLING PLAN

A sampling plan for each AQL value shall be selected from Table B-3 or B-4 as follows:

B9.1 Determination of Sample Size Code Letter. The sample size code letter shall be selected from Table A-2 in accordance with paragraph A7.1.

B9.2 Master Sampling Tables. The master sampling tables for plans based on variability unknown for a double specification limit when using the standard deviation method are Tables B-3 and B-4. Table B-3 is used for normal and tightened inspection and Table B-4 for reduced inspection.

B9.3 Obtaining Sampling Plan. A sampling plan consists of a sample size and the associated maximum allowable percent nonconforming. The sampling plan to be applied in inspection shall be obtained from Master Table B-3 or B-4.

B9.3.1 Sample Size. The sample size n is shown in the master tables corresponding to each sample size code letter.

B9.3.2 Maximum Allowable Percent Nonconforming. The maximum allowable percent nonconforming for sample estimates of percent nonconforming for the lower, upper, or both specification limits combined, corresponding to the sample size mentioned in paragraph B9.3.1, is shown in the column of the master table corresponding to the applicable AQL value(s). If different AQLs are assigned to each specification limit, designate the maximum allowable percent nonconforming by M_L for the lower limit, and by M_U for the upper limit. If one AQL is assigned to both limits combined, designate the maximum allowable percent nonconforming by M. Table B-3 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table B-4.

B10. DRAWING OF SAMPLES

Samples shall be selected in accordance with paragraph A7.2.

B11. LOT-BY-LOT ACCEPTABILITY PROCEDURES

B11.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a double specification limit shall be judged by the percent of nonconforming product. The percentage of nonconforming product is estimated by entering Table B-5 with the quality index and the sample size.

B11.2 Computation of Quality Indices. The quality indices $Q_U = (U - \bar{X})/s$ and $Q_L = (\bar{X} - L)/s$ shall be computed, where

U is the upper specification limit,
L is the lower specification limit,
$\bar{X}$ is the sample mean, and
s is the estimate of lot standard deviation.

B11.3 Percent Nonconforming in the Lot. The quality of a lot shall be expressed in terms of the lot percent nonconforming. Its estimate will be designated by p_L, p_U, or p. The estimate p_U indicates conformance with respect to the upper specification limit, p_L with respect to the lower specification limit, and p for both specification limits combined. The estimates p_L and p_U shall be determined by entering Table B-5, respectively with Q_L and Q_U and the sample size. The estimate p shall be determined by adding the corresponding estimated percents nonconforming p_L and p_U found in the table.

B12. ACCEPTABILITY CRITERION AND SUMMARY FOR OPERATION OF SAMPLING PLANS

B12.1 One AQL value for both Upper and Lower Specification Limit Combined.

B12.1.1 Acceptability Criterion.[4] Compare the estimated lot percent nonconforming $p = p_L + p_U$ with the maximum allowable percent nonconforming M. If p is equal to or less than M, the lot meets the acceptability criterion; if p is greater than M or if either Q_U or Q_L or both are negative, then the lot does not meet the acceptability criterion.

B12.1.2 Summary for Operation of Sampling Plan. In cases where a single AQL value is established for the upper and lower specification limit combined for a single quality characteristic, the following steps summarize the procedures to be used:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Select plan from Master Table B-3 or B-4. Obtain the sample size n and the maximum allowable percent nonconforming M.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit of the sample.

(4) Compute the sample mean $\bar{X}$ and estimate a lot of standard deviation s.

(5) Compute the quality indices $Q_U = (U - \bar{X})/s$ and $Q_L = (\bar{X} - L)/s$.

(6) Determine the estimated lot percent nonconforming $p = p_U + p_L$ from Table B-5.

(7) If the estimated lot percent nonconforming p is equal to or less than the maximum allowable percent nonconforming M, the lot meets the acceptability criterion; if p is greater than M or if either Q_U or Q_L or both are negative, then the lot does not meet the acceptability criterion.

B12.2 Different AQL Values for Upper and Lower Specification Limit.

B12.2.1 Acceptability Criteria.[5] Compare the estimated lot percents nonconforming p_L and p_U with the corresponding maximum allowable percents nonconforming M_L and M_U; also compare $p = p_L + p_U$ with the larger of M_L and M_U. If p_L is equal to or less than M_L, p_U is equal to or less than M_U, and p is equal to or less than the larger of M_L and M_U, the lot meets the acceptability criteria; otherwise, the lot does not meet the acceptability criteria. If either Q_L or Q_U or both are negative, then the lot does not meet the acceptability criteria.

B12.2.2 Summary for Operation of Sampling Plan. In cases where a different AQL value is established for the upper and lower specification limit for a single quality characteristic, the following steps summarize the procedures to be used:

(1) Determine the sample size code letter from Table A-2 by using the lot size and inspection level.

(2) Select the sampling plan from Master Table B-3 or B-4. Obtain the sample size n and the maximum allowable percents nonconforming M_U or M_L, corresponding to the AQL values for the upper and lower specification limits, respectively.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit in the sample.

(4) Compute the sample mean $\bar{X}$ and estimate a lot standard deviation s.

(5) Compute the quality indices $Q_U = (U - \bar{X})/s$ and $Q_L = (\bar{X} - L)/s$.

(6) Determine the estimated lot percents nonconforming p_L and p_U corresponding to the percents nonconforming above the upper and below the lower specification limits. Also determine the combined percent nonconforming $p = p_L + p_U$.

(7) If all three of the following conditions:

(a) p_U is equal to or less than M_U,

(b) p_L is equal to or less than M_L,

(c) p is equal to or less than the larger of M_L and M_U,

are satisfied, the lot meets the acceptability criteria; otherwise the lot does not meet the acceptability criteria. If either Q_L or Q_U or both are negative, then the lot does not meet the acceptability criteria.

[4]See Example B-3 for a complete example of this procedure.

[5]See Example B-4 for a complete example of this procedure.

EXAMPLE B-3

Example of Calculations

Double Specification Limit

Variability Unknown—Standard Deviation Method

One AQL Value for Both Upper and Lower Specification Limit Combined

Example: The minimum temperature of operation for a certain device is specified as 180°F. The maximum temperature is 209°F. A lot of 40 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1% is to be used. From Tables A-2 and B-3 it is seen that a sample of size 5 is required. Suppose the measurements obtained are as follows: 197°, 188°, 184°, 205°, and 201°; and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	5	
2	Sum of Measurements: ΣX	975	
3	Sum of Squared Measurements: ΣX^2	190,435	
4	Correction Factor (CF): $(\Sigma X)^2/n$	190,125	$(975)^2/5$
5	Corrected Sum of Squares (SS): $\Sigma X^2 - CF$	310	190,435 – 190,125
6	Variance (V): $SS/(n-1)$	77.5	310/4
7	Estimate of Lot Standard Deviation s: $\sqrt{V}$	8.81	$\sqrt{77.5}$
8	Sample Mean $\overline{X}$: $\Sigma X/n$	195	975/5
9	Upper Specification Limit: U	209	
10	Lower Specification Limit: L	180	
11	Quality Index: $Q_U = (U - \overline{X})/s$	1.59	(209 – 195)/8.81
12	Quality Index: $Q_L = (\overline{X} - L)/s$	1.70	(195 – 180)/8.81
13	Est. of Lot Percent Ncf. above U: p_U	2.19%	See Table B-5
14	Est. of Lot Percent Ncf. below L: p_L	.66%	See Table B-5
15	Total Est. Percent Ncf. in Lot: $p = p_U + p_L$	2.85%	2.19% + .66%
16	Max. Allowable Percent Ncf.: M	3.32%	See Table B-3
17	Acceptability Criterion:		
	Compare $p = p_U + p_L$ with M	2.85% < 3.32%	See Para. B12.1.2(7)

The lot meets the acceptability criterion, since $p = p_U + p_L$ is less than M.

EXAMPLE B-4

Example of Calculations

Double Specification Limit

Variability Unknown—Standard Deviation Method

Different AQL Values for Upper and Lower Specification Limits

Example: The minimum temperature of operation for a certain device is specified as 180°F. The maximum temperature is 209°F. A lot of 40 items is submitted for inspection. Inspection Level II, normal inspection, with *AQL = 1% for the upper and AQL = 2.5% for the lower specification limit is to be used.* From Tables A-2 and B-3 it is seen that a sample of size 5 is required. Supposed the measurements obtained are as follows: 197°, 188°, 184°, 205°, and 201°; and compliance with the acceptability criteria is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	5	
2	Sum of Measurements: ΣX	975	
3	Sum of Squared Measurements: ΣX^2	190,435	
4	Correction Factor (CF): $(\Sigma X)^2/n$	190,125	$(975)^2/5$
5	Corrected Sum of Squares (SS): $\Sigma X^2 - CF$	310	190,435 – 190,125
6	Variance (V): $SS/(n-1)$	77.5	310/4
7	Estimate of Lot Standard Deviation s: $\sqrt{V}$	8.80	$\sqrt{77.5}$
8	Sample Mean $\overline{X}$: $\Sigma X/n$	195	975/5
9	Upper Specification Limit: U	209	
10	Lower Specification Limit: L	180	
11	Quality Index: $Q_U = (U - \overline{X})/s$	1.59	(209 – 195)/8.80
12	Quality Index: $Q_L = (\overline{X} - L)/s$	1.70	(195 – 180)/8.80
13	Est. of Lot Percent Ncf. above U: p_U	2.19%	See Table B-5
14	Est. of Lot Percent Ncf. below L: p_L	.66%	See Table B-5
15	Total Est. Percent Ncf. in Lot: $p = p_U + p_L$	2.85%	2.19% + .66%
16	Max. Allowable Percent Ncf. Above U: M_U	3.32%	See Table B-3
17	Max. Allowable Percent Ncf. below L: M_L	9.80%	See Table B-3
18	Acceptability Criteria: (a) Compare p_U with M_U	2.19% < 3.32%	See Para. B12.2.2(7)(a)
	(b) Compare p_L with M_L	.66% < 9.80%	See Para. B12.2.2(7)(b)
	(c) Compare p with M_L	2.85% < 9.80%	See Para. B12.2.2(7)(c)

The lot meets the acceptability criteria, since 18(a), (b), and (c) are satisfied; i.e., $p_U < M_U$, $p_L < M_L$, and $p < M_L$.

Table B-3

Master Table for Normal and Tightened Inspection for Plans Based on Variability Unknown
(Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Sample size	Acceptable Quality Levels (normal inspection)											
		T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		M	M	M	M	M	M	M	M	M	M	M	M
B	3	↓	↓	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69
C	4	↓	↓	↓	↓	↓	↓	1.49	5.46	10.88	16.41	22.84	29.43
D	5	↓	↓	↓	↓	0.041	1.34	3.33	5.82	9.80	14.37	20.19	26.55
E	7	↓	0.005	0.087	0.421	1.05	2.13	3.54	5.34	8.40	12.19	17.34	23.30
F	10	0.077	0.179	0.349	0.714	1.27	2.14	3.27	4.72	7.26	10.53	15.17	20.73
G	15	0.186	0.311	0.491	0.839	1.33	2.09	3.06	4.32	6.55	9.48	13.74	18.97
H	20	0.228	0.356	0.531	0.864	1.33	2.03	2.93	4.10	6.18	8.95	13.01	18.07
I	25	0.250	0.378	0.551	0.874	1.32	2.00	2.86	3.97	5.98	8.65	12.60	17.55
J	35	0.253	0.373	0.534	0.833	1.24	1.87	2.66	3.70	5.58	8.11	11.89	16.67
K	50	0.243	0.355	0.503	0.778	1.16	1.73	2.47	3.44	5.21	7.61	11.23	15.87
L	75	0.225	0.326	0.461	0.711	1.06	1.59	2.27	3.17	4.83	7.10	10.58	15.07
M	100	0.218	0.315	0.444	0.684	1.02	1.52	2.18	3.06	4.67	6.88	10.29	14.71
N	150	0.202	0.292	0.412	0.636	0.946	1.42	2.05	2.88	4.42	6.56	9.86	14.18
P	200	0.204	0.294	0.414	0.637	0.945	1.42	2.04	2.86	4.39	6.52	9.80	14.11
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00	
		Acceptable Quality Levels (tightened inspection)											

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table B-4 Standard Deviation Method

Master Table for Reduced Inspection for Plans Based on Variability Unknown
(Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Sample size	Acceptable Quality Levels										
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		M	M	M	M	M	M	M	M	M	M	M
B	3	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69	40.47
C	3	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69	40.47
D	3	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69	40.47
E	3	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69	40.47
F	4	↓	↓	↓	↓	1.49	5.46	10.88	16.41	22.84	29.43	36.79
G	5	↓	↓	0.041	1.34	3.33	5.82	9.80	14.37	20.19	26.55	33.94
H	7	0.087	0.421	1.06	2.13	3.54	5.34	8.40	12.19	17.34	23.30	30.50
I	10	0.349	0.714	1.27	2.14	3.27	4.72	7.26	10.53	15.17	20.73	27.65
J	15	0.491	0.839	1.33	2.09	3.06	4.32	6.55	9.48	13.74	18.97	25.63
K	20	0.531	0.864	1.33	2.03	2.93	4.10	6.18	8.95	13.01	18.07	24.58
L	25	0.551	0.874	1.32	2.00	2.86	3.97	5.98	8.65	12.60	17.55	23.97
M	30	0.567	0.885	1.32	1.98	2.82	3.91	5.87	8.48	12.37	17.25	23.61
N	50	0.503	0.778	1.16	1.73	2.47	3.44	5.21	7.61	11.23	15.87	21.99
P	75	0.461	0.711	1.06	1.59	2.27	3.17	4.83	7.10	10.58	15.07	21.05

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table B-5

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
0	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
.1	47.24	46.67	46.44	46.26	46.16	46.10	46.08	46.06	46.05	46.05	46.04	46.03	46.03	46.02	46.02
.2	44.46	43.33	42.90	42.54	42.35	42.24	42.19	42.16	42.15	42.13	42.11	42.10	42.09	42.09	42.08
.3	41.63	40.00	39.37	38.87	38.60	38.44	38.37	38.33	38.31	38.29	38.27	38.25	38.24	38.23	38.22
.31	41.35	39.67	39.02	38.50	38.23	38.06	37.99	37.95	37.93	37.91	37.89	37.87	37.86	37.85	37.84
.32	41.06	39.33	38.67	38.14	37.86	37.69	37.62	37.58	37.55	37.54	37.51	37.49	37.48	37.47	37.46
.33	40.77	39.00	38.32	37.78	37.49	37.31	37.24	37.20	37.18	37.16	37.13	37.11	37.10	37.09	37.08
.34	40.49	38.67	37.97	37.42	37.12	36.94	36.87	36.83	36.80	36.78	36.75	36.73	36.72	36.71	36.71
.35	40.20	38.33	37.62	37.06	36.75	36.57	36.49	36.45	36.43	36.41	36.38	36.36	36.35	36.34	36.33
.36	39.91	38.00	37.28	36.69	36.38	36.20	36.12	36.08	36.05	36.04	36.01	35.98	35.97	35.96	35.96
.37	39.62	37.67	36.93	36.33	36.02	35.83	35.75	35.71	35.68	35.66	35.63	35.61	35.60	35.59	35.58
.38	39.33	37.33	36.58	35.98	35.65	35.46	35.38	35.34	35.31	35.29	35.26	35.24	35.23	35.22	35.21
.39	39.03	37.00	36.23	35.62	35.29	35.10	35.02	34.97	34.94	34.93	34.89	34.87	34.86	34.85	34.84
.40	38.74	36.67	35.88	35.26	34.93	34.73	34.65	34.60	34.58	34.56	34.53	34.50	34.49	34.48	34.47
.41	38.45	36.33	35.54	34.90	34.57	34.37	34.28	34.24	34.21	34.19	34.16	34.13	34.12	34.11	34.11
.42	38.15	36.00	35.19	34.55	34.21	34.00	33.92	33.87	33.85	33.83	33.79	33.77	33.76	33.75	33.74
.43	37.85	35.67	34.85	34.19	33.85	33.64	33.56	33.51	33.48	33.46	33.43	33.40	33.39	33.38	33.38
.44	37.56	35.33	34.50	33.84	33.49	33.28	33.20	33.15	33.12	33.10	33.07	33.04	33.03	33.02	33.01
.45	37.26	35.00	34.16	33.49	33.13	32.92	32.84	32.79	32.76	32.74	32.71	32.68	32.67	32.66	32.65
.46	36.96	34.67	33.81	33.13	32.78	32.57	32.48	32.43	32.40	32.38	32.35	32.32	32.31	32.30	32.29
.47	36.66	34.33	33.47	32.78	32.42	32.21	32.12	32.07	32.04	32.02	31.99	31.96	31.95	31.94	31.93
.48	36.35	34.00	33.12	32.43	32.07	31.85	31.77	31.72	31.69	31.67	31.63	31.61	31.60	31.58	31.58
.49	36.05	33.67	32.78	32.08	31.72	31.50	31.41	31.36	31.33	31.31	31.28	31.25	31.24	31.23	31.22
.50	35.75	33.33	32.44	31.74	31.37	31.15	31.06	31.01	30.98	30.96	30.93	30.90	30.89	30.88	30.87
.51	35.44	33.00	32.10	31.39	31.02	30.80	30.71	30.66	30.63	30.61	30.57	30.55	30.54	30.53	30.52
.52	35.13	32.67	31.76	31.04	30.67	30.45	30.36	30.31	30.28	30.26	30.23	30.20	30.19	30.18	30.17
.53	34.82	32.33	31.42	30.70	30.32	30.10	30.01	29.96	29.93	29.91	29.88	29.85	29.84	29.83	29.82
.54	34.51	32.00	31.08	30.36	29.98	29.76	29.67	29.62	29.59	29.57	29.53	29.51	29.49	29.48	29.48
.55	34.20	31.67	30.74	30.01	29.64	29.41	29.32	29.27	29.24	29.22	29.19	29.16	29.15	29.14	29.13
.56	33.88	31.33	30.40	29.67	29.29	29.07	28.98	28.93	28.90	28.88	28.85	28.82	28.81	28.80	28.79
.57	33.57	31.00	30.06	29.33	28.95	28.73	28.64	28.59	28.56	28.54	28.51	28.48	28.47	28.46	28.45
.58	33.25	30.67	29.73	28.99	28.61	28.39	28.30	28.25	28.22	28.20	28.17	28.14	28.13	28.12	28.11
.59	32.93	30.33	29.39	28.66	28.28	28.05	27.96	27.92	27.89	27.87	27.83	27.81	27.79	27.78	27.78
.60	32.61	30.00	29.05	28.32	27.94	27.72	27.63	27.58	27.55	27.53	27.50	27.47	27.46	27.45	27.44
.61	32.28	29.67	28.72	27.98	27.60	27.39	27.30	27.25	27.22	27.20	27.16	27.14	27.13	27.11	27.11
.62	31.96	29.33	28.39	27.65	27.27	27.05	26.96	26.92	26.89	26.87	26.83	26.81	26.80	26.78	26.78
.63	31.63	29.00	28.05	27.32	26.94	26.72	26.63	26.59	26.56	26.54	26.50	26.48	26.47	26.46	26.45
.64	31.30	28.67	27.72	26.99	26.61	26.39	26.31	26.26	26.23	26.21	26.18	26.15	26.14	26.13	26.12
.65	30.97	28.33	27.39	26.66	26.28	26.07	25.98	25.93	25.90	25.88	25.85	25.83	25.82	25.81	25.80
.66	30.63	28.00	27.06	26.33	25.96	25.74	25.66	25.61	25.58	25.56	25.53	25.51	25.49	25.48	25.48
.67	30.30	27.67	26.73	26.00	25.63	25.42	25.33	25.29	25.26	25.24	25.21	25.19	25.17	25.16	25.16
.68	29.96	27.33	26.40	25.68	25.31	25.10	25.01	24.97	24.94	24.92	24.89	24.87	24.86	24.85	24.84
.69	29.61	27.00	26.07	25.35	24.99	24.78	24.70	24.65	24.62	24.60	24.57	24.55	24.54	24.53	24.52

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
.70	29.27	26.67	25.74	25.03	24.67	24.46	24.38	24.33	24.31	24.29	24.26	24.24	24.23	24.22	24.21
.71	28.92	26.33	25.41	24.71	24.35	24.15	24.06	24.02	23.99	23.98	23.95	23.92	23.91	23.90	23.90
.72	28.57	26.00	25.09	24.39	24.03	23.83	23.75	23.71	23.68	23.67	23.64	23.61	23.60	23.59	23.59
.73	28.22	25.67	24.76	24.07	23.72	23.52	23.44	23.40	23.37	23.36	23.33	23.31	23.30	23.29	23.28
.74	27.86	25.33	24.44	23.75	23.41	23.21	23.13	23.09	23.07	23.05	23.02	23.00	22.99	22.98	22.98
.75	27.50	25.00	24.11	23.44	23.10	22.90	22.83	22.79	22.76	22.75	22.72	22.70	22.69	22.68	22.68
.76	27.13	24.67	23.79	23.12	22.79	22.60	22.52	22.48	22.46	22.44	22.42	22.40	22.39	22.38	22.38
.77	26.76	24.33	23.47	22.81	22.48	22.30	22.22	22.18	22.16	22.14	22.12	22.10	22.09	22.08	22.08
.78	26.39	24.00	23.15	22.50	22.18	21.99	21.92	21.89	21.86	21.85	21.82	21.80	21.78	21.79	21.78
.79	26.02	23.67	22.83	22.19	21.87	21.70	21.63	21.59	21.57	21.55	21.53	21.51	21.50	21.49	21.49
.80	25.64	23.33	22.51	21.88	21.57	21.40	21.33	21.29	21.27	21.26	21.23	21.22	21.21	21.20	21.20
.81	25.25	23.00	22.19	21.58	21.27	21.10	21.04	21.00	20.98	20.97	20.94	20.93	20.92	20.91	20.91
.82	24.86	22.67	21.87	21.27	20.98	20.81	20.75	20.71	20.69	20.68	20.65	20.64	20.63	20.62	20.62
.83	24.47	22.33	21.56	20.97	20.68	20.52	20.46	20.42	20.40	20.39	20.37	20.35	20.35	20.34	20.34
.84	24.07	22.00	21.24	20.67	20.39	20.23	20.17	20.14	20.12	20.11	20.09	20.07	20.06	20.06	20.05
.85	23.67	21.67	20.93	20.37	20.10	19.94	19.89	19.86	19.84	19.82	19.80	19.79	19.78	19.78	19.77
.86	23.26	21.33	20.62	20.07	19.81	19.66	19.60	19.57	19.56	19.54	19.53	19.51	19.51	19.50	19.50
.87	22.84	21.00	20.31	19.78	19.52	19.38	19.32	19.30	19.28	19.27	19.25	19.24	19.23	19.23	19.22
.88	22.42	20.67	20.00	19.48	19.23	19.10	19.05	19.02	19.00	18.99	18.98	18.96	18.96	18.95	18.95
.89	21.99	20.33	19.69	19.19	18.95	18.82	18.77	18.74	18.73	18.72	18.70	18.69	18.69	18.68	18.68
.90	21.55	20.00	19.38	18.90	18.67	18.54	18.50	18.47	18.46	18.45	18.43	18.42	18.42	18.41	18.41
.91	21.11	19.67	19.07	18.61	18.39	18.27	18.23	18.20	18.19	18.18	18.17	18.16	18.15	18.15	18.15
.92	20.66	19.33	18.77	18.33	18.11	18.00	17.96	17.94	17.92	17.92	17.90	17.89	17.89	17.89	17.88
.93	20.19	19.00	18.46	18.04	17.84	17.73	17.69	17.67	17.66	17.65	17.64	17.63	17.63	17.62	17.62
.94	19.73	18.67	18.16	17.76	17.56	17.46	17.43	17.41	17.40	17.39	17.38	17.37	17.37	17.37	17.36
.95	19.25	18.33	17.86	17.48	17.29	17.20	17.17	17.16	17.14	17.13	17.12	17.12	17.11	17.11	17.11
.96	18.75	18.00	17.55	17.20	17.03	16.94	16.90	16.89	16.88	16.88	16.87	16.86	16.86	16.86	16.86
.97	18.25	17.67	17.25	16.92	16.76	16.68	16.65	16.63	16.63	16.62	16.61	16.61	16.61	16.61	16.60
.98	17.74	17.33	16.96	16.65	16.49	16.42	16.39	16.38	16.37	16.37	16.36	16.36	16.36	16.36	16.36
.99	17.21	17.00	16.66	16.37	16.23	16.16	16.14	16.13	16.12	16.12	16.12	16.11	16.11	16.11	16.11
1.00	16.67	16.67	16.36	16.10	15.97	15.91	15.89	15.88	15.88	15.87	15.87	15.87	15.87	15.87	15.87
1.01	16.11	16.33	16.07	15.83	15.72	15.66	15.64	15.63	15.63	15.63	15.63	15.62	15.62	15.62	15.62
1.02	15.53	16.00	15.78	15.56	15.46	15.41	15.40	15.39	15.39	15.38	15.38	15.38	15.38	15.39	15.39
1.03	14.93	15.67	15.48	15.30	15.21	15.17	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15
1.04	14.31	15.33	15.19	15.03	14.96	14.92	14.91	14.91	14.91	14.91	14.91	14.91	14.91	14.91	14.91
1.05	13.66	15.00	14.91	14.77	14.71	14.68	14.67	14.67	14.67	14.67	14.68	14.68	14.68	14.68	14.68
1.06	12.98	14.67	14.62	14.51	14.46	14.44	14.44	14.44	14.44	14.44	14.45	14.45	14.45	14.45	14.45
1.07	12.27	14.33	14.33	14.26	14.22	14.20	14.20	14.21	14.21	14.21	14.22	14.22	14.22	14.23	14.22
1.08	11.51	14.00	14.05	14.00	13.97	13.97	13.97	13.98	13.98	13.98	13.99	13.99	14.00	14.00	14.00
1.09	10.71	13.67	13.76	13.75	13.73	13.74	13.74	13.75	13.75	13.76	13.77	13.77	13.77	13.78	13.78

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
1.10	9.84	13.33	13.48	13.49	13.50	13.51	13.52	13.52	13.53	13.54	13.54	13.55	13.55	13.56	13.56
1.11	8.89	13.00	13.20	13.25	13.26	13.28	13.29	13.30	13.31	13.31	13.32	13.33	13.34	13.34	13.34
1.12	7.82	12.67	12.93	13.00	13.03	13.05	13.07	13.08	13.09	13.10	13.11	13.12	13.12	13.13	13.13
1.13	6.60	12.33	12.65	12.75	12.80	12.83	12.85	12.86	12.87	12.88	12.89	12.90	12.91	12.91	12.92
1.14	5.08	12.00	12.37	12.51	12.57	12.61	12.63	12.65	12.66	12.67	12.68	12.69	12.70	12.70	12.71
1.15	2.87	11.67	12.10	12.27	12.34	12.39	12.42	12.44	12.45	12.46	12.47	12.48	12.49	12.49	12.50
1.16	0.00	11.33	11.83	12.03	12.12	12.18	12.21	12.22	12.24	12.25	12.26	12.28	12.28	12.29	12.29
1.17	0.00	11.00	11.56	11.79	11.90	11.96	12.00	12.02	12.03	12.04	12.06	12.07	12.08	12.09	12.09
1.18	0.00	10.67	11.29	11.56	11.68	11.75	11.79	11.81	11.82	11.84	11.85	11.87	11.88	11.88	11.89
1.19	0.00	10.33	11.02	11.33	11.46	11.54	11.58	11.61	11.62	11.63	11.65	11.67	11.68	11.69	11.69
1.20	0.00	10.00	10.76	11.10	11.24	11.34	11.38	11.41	11.42	11.43	11.46	11.47	11.48	11.49	11.49
1.21	0.00	9.67	10.50	10.87	11.03	11.13	11.18	11.21	11.22	11.24	11.26	11.28	11.29	11.30	11.30
1.22	0.00	9.33	10.23	10.65	10.82	10.93	10.98	11.01	11.03	11.04	11.07	11.09	11.09	11.10	11.11
1.23	0.00	9.00	9.97	10.42	10.61	10.73	10.78	10.81	10.84	10.85	10.88	10.90	10.91	10.92	10.92
1.24	0.00	8.67	9.72	10.20	10.41	10.53	10.59	10.62	10.64	10.66	10.69	10.71	10.72	10.73	10.73
1.25	0.00	8.33	9.46	9.98	10.21	10.34	10.40	10.43	10.46	10.47	10.50	10.52	10.53	10.54	10.55
1.26	0.00	8.00	9.21	9.77	10.00	10.15	10.21	10.25	10.27	10.29	10.32	10.34	10.35	10.36	10.37
1.27	0.00	7.67	8.96	9.55	9.81	9.96	10.02	10.06	10.09	10.10	10.13	10.16	10.17	10.18	10.19
1.28	0.00	7.33	8.71	9.34	9.61	9.77	9.84	9.88	9.90	9.92	9.95	9.98	9.99	10.00	10.01
1.29	0.00	7.00	8.46	9.13	9.42	9.58	9.66	9.70	9.72	9.74	9.78	9.80	9.82	9.83	9.83
1.30	0.00	6.67	8.21	8.93	9.22	9.40	9.48	9.52	9.55	9.57	9.60	9.63	9.64	9.65	9.66
1.31	0.00	6.33	7.97	8.72	9.03	9.22	9.30	9.34	9.37	9.39	9.43	9.46	9.47	9.48	9.49
1.32	0.00	6.00	7.73	8.52	8.85	9.04	9.12	9.17	9.20	9.22	9.26	9.29	9.30	9.31	9.32
1.33	0.00	5.67	7.49	8.32	8.66	8.86	8.95	9.00	9.03	9.05	9.09	9.12	9.13	9.15	9.15
1.34	0.00	5.33	7.25	8.12	8.48	8.69	8.78	8.83	8.86	8.88	8.92	8.95	8.97	8.98	8.99
1.35	0.00	5.00	7.02	7.92	8.30	8.52	8.61	8.66	8.69	8.72	8.76	8.79	8.81	8.82	8.83
1.36	0.00	4.67	6.79	7.73	8.12	8.35	8.44	8.50	8.53	8.55	8.60	8.63	8.65	8.66	8.67
1.37	0.00	4.33	6.56	7.54	7.95	8.18	8.28	8.33	8.37	8.39	8.44	8.47	8.49	8.50	8.51
1.38	0.00	4.00	6.33	7.35	7.77	8.01	8.12	8.17	8.21	8.24	8.28	8.31	8.33	8.35	8.36
1.39	0.00	3.67	6.10	7.17	7.60	7.85	7.96	8.01	8.05	8.08	8.12	8.16	8.18	8.19	8.20
1.40	0.00	3.33	5.88	6.98	7.44	7.69	7.80	7.86	7.90	7.92	7.97	8.01	8.02	8.04	8.05
1.41	0.00	3.00	5.66	6.80	7.27	7.53	7.64	7.70	7.74	7.77	7.82	7.86	7.87	7.89	7.90
1.42	0.00	2.67	5.44	6.62	7.10	7.37	7.49	7.55	7.59	7.62	7.67	7.71	7.73	7.74	7.75
1.43	0.00	2.33	5.23	6.45	6.94	7.22	7.34	7.40	7.44	7.47	7.52	7.56	7.58	7.60	7.61
1.44	0.00	2.00	5.02	6.27	6.78	7.07	7.19	7.26	7.30	7.33	7.38	7.42	7.44	7.46	7.47
1.45	0.00	1.67	4.81	6.10	6.63	6.92	7.04	7.11	7.15	7.18	7.24	7.28	7.30	7.32	7.32
1.46	0.00	1.33	4.60	5.93	6.47	6.77	6.90	6.97	7.01	7.04	7.10	7.14	7.16	7.18	7.19
1.47	0.00	1.00	4.39	5.77	6.32	6.63	6.75	6.83	6.87	6.90	6.96	7.00	7.02	7.04	7.05
1.48	0.00	.67	4.19	5.60	6.17	6.48	6.61	6.69	6.73	6.77	6.82	6.86	6.88	6.90	6.91
1.49	0.00	.33	3.99	5.44	6.02	6.34	6.48	6.55	6.60	6.63	6.69	6.73	6.75	6.77	6.78

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
1.50	0.00	0.00	3.80	5.28	5.87	6.20	6.34	6.41	6.46	6.50	6.55	6.60	6.62	6.64	6.65
1.51	0.00	0.00	3.61	5.13	5.73	6.06	6.20	6.28	6.33	6.36	6.42	6.47	6.49	6.51	6.52
1.52	0.00	0.00	3.42	4.97	5.59	5.93	6.07	6.15	6.20	6.23	6.29	6.34	6.36	6.38	6.39
1.53	0.00	0.00	3.23	4.82	5.45	5.80	5.94	6.02	6.07	6.11	6.17	6.21	6.24	6.26	6.27
1.54	0.00	0.00	3.05	4.67	5.31	5.67	5.81	5.89	5.95	5.98	6.04	6.09	6.11	6.13	6.15
1.55	0.00	0.00	2.87	4.52	5.18	5.54	5.69	5.77	5.82	5.86	5.92	5.97	5.99	6.01	6.02
1.56	0.00	0.00	2.69	4.38	5.05	5.41	5.56	5.65	5.70	5.74	5.80	5.85	5.87	5.89	5.90
1.57	0.00	0.00	2.52	4.24	4.92	5.29	5.44	5.53	5.58	5.62	5.68	5.73	5.75	5.78	5.79
1.58	0.00	0.00	2.35	4.10	4.79	5.16	5.32	5.41	5.46	5.50	5.56	5.61	5.64	5.66	5.67
1.59	0.00	0.00	2.19	3.96	4.66	5.04	5.20	5.29	5.34	5.38	5.45	5.50	5.52	5.55	5.56
1.60	0.00	0.00	2.03	3.83	4.54	4.92	5.08	5.17	5.23	5.27	5.33	5.38	5.41	5.43	5.44
1.61	0.00	0.00	1.87	3.69	4.41	4.81	4.97	5.06	5.12	5.16	5.22	5.27	5.30	5.32	5.33
1.62	0.00	0.00	1.72	3.57	4.30	4.69	4.86	4.95	5.01	5.04	5.11	5.16	5.19	5.21	5.23
1.63	0.00	0.00	1.57	3.44	4.18	4.58	4.75	4.84	4.90	4.94	5.01	5.06	5.08	5.11	5.12
1.64	0.00	0.00	1.42	3.31	4.06	4.47	4.64	4.73	4.79	4.83	4.90	4.95	4.98	5.00	5.01
1.65	0.00	0.00	1.28	3.19	3.95	4.36	4.53	4.62	4.68	4.72	4.79	4.85	4.87	4.90	4.91
1.66	0.00	0.00	1.15	3.07	3.84	4.25	4.43	4.52	4.58	4.62	4.69	4.74	4.77	4.80	4.81
1.67	0.00	0.00	1.02	2.95	3.73	4.15	4.32	4.42	4.48	4.52	4.59	4.64	4.67	4.70	4.71
1.68	0.00	0.00	0.89	2.84	3.62	4.05	4.22	4.32	4.38	4.42	4.49	4.55	4.57	4.60	4.61
1.69	0.00	0.00	0.77	2.73	5.52	3.94	4.12	4.22	4.28	4.32	4.39	4.45	4.47	4.50	4.51
1.70	0.00	0.00	0.66	2.62	3.41	3.84	4.02	4.12	4.18	4.22	4.30	4.35	4.38	4.41	4.42
1.71	0.00	0.00	0.55	2.51	3.31	3.75	3.93	4.02	4.09	4.13	4.20	4.26	4.29	4.31	4.32
1.72	0.00	0.00	0.45	2.41	3.21	3.65	3.83	3.93	3.99	4.04	4.11	4.17	4.19	4.22	4.23
1.73	0.00	0.00	0.36	2.30	3.11	3.56	3.74	3.84	3.90	3.94	4.02	4.08	4.10	4.13	4.14
1.74	0.00	0.00	0.27	2.20	3.02	3.46	3.65	3.75	3.81	3.85	3.93	3.99	4.01	4.04	4.05
1.75	0.00	0.00	0.19	2.11	2.93	3.37	3.56	3.66	3.72	3.77	3.84	3.90	3.93	3.95	3.97
1.76	0.00	0.00	0.12	2.01	2.83	3.28	3.47	3.57	3.63	3.68	3.76	3.81	3.84	3.87	3.88
1.77	0.00	0.00	0.06	1.92	2.74	3.20	3.38	3.48	3.55	3.59	3.67	3.73	3.76	3.78	3.80
1.78	0.00	0.00	0.02	1.83	2.66	3.11	3.30	3.40	3.47	3.51	3.59	3.64	3.67	3.70	3.71
1.79	0.00	0.00	0.00	1.74	2.57	3.03	3.21	3.32	3.38	3.43	3.51	3.56	3.59	3.62	3.63
1.80	0.00	0.00	0.00	1.65	2.49	2.94	3.13	3.24	3.30	3.35	3.43	3.48	3.51	3.54	3.55
1.81	0.00	0.00	0.00	1.57	2.40	2.86	3.05	3.16	3.22	3.27	3.35	3.40	3.43	3.46	3.47
1.82	0.00	0.00	0.00	1.49	2.32	2.79	2.98	3.08	3.15	3.19	3.27	3.33	3.36	3.38	3.40
1.83	0.00	0.00	0.00	1.41	2.25	2.71	2.90	3.00	3.07	3.11	3.19	3.25	3.28	3.31	3.32
1.84	0.00	0.00	0.00	1.34	2.17	2.63	2.82	2.93	2.99	3.04	3.12	3.18	3.21	3.23	3.25
1.85	0.00	0.00	0.00	1.26	2.09	2.56	2.75	2.85	2.92	2.97	3.05	3.10	3.13	3.16	3.17
1.86	0.00	0.00	0.00	1.19	2.02	2.48	2.68	2.78	2.85	2.89	2.97	3.03	3.06	3.09	3.10
1.87	0.00	0.00	0.00	1.12	1.95	2.41	2.61	2.71	2.78	2.82	2.90	2.96	2.99	3.02	3.03
1.88	0.00	0.00	0.00	1.06	1.88	2.34	2.54	2.64	2.71	2.75	2.83	2.89	2.92	2.95	2.96
1.89	0.00	0.00	0.00	0.99	1.81	2.28	2.47	2.57	2.64	2.69	2.77	2.83	2.85	2.88	2.90

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
1.90	0.00	0.00	0.00	0.93	1.75	2.21	2.40	2.51	2.57	2.62	2.70	2.76	2.79	2.82	2.83
1.91	0.00	0.00	0.00	0.87	1.68	2.14	2.34	2.44	2.51	2.56	2.63	2.69	2.72	2.75	2.77
1.92	0.00	0.00	0.00	0.81	1.62	2.08	2.27	2.38	2.45	2.49	2.57	2.63	2.66	2.69	2.70
1.93	0.00	0.00	0.00	0.76	1.56	2.02	2.21	2.32	2.38	2.43	2.51	2.57	2.60	2.63	2.64
1.94	0.00	0.00	0.00	0.70	1.50	1.96	2.15	2.25	2.32	2.37	2.45	2.51	2.54	2.56	2.58
1.95	0.00	0.00	0.00	0.65	1.44	1.90	2.09	2.19	2.26	2.31	2.39	2.45	2.48	2.50	2.52
1.96	0.00	0.00	0.00	0.60	1.38	1.84	2.03	2.14	2.20	2.25	2.33	2.39	2.42	2.44	2.46
1.97	0.00	0.00	0.00	0.56	1.33	1.78	1.97	2.08	2.14	2.19	2.27	2.33	2.36	2.39	2.40
1.98	0.00	0.00	0.00	0.51	1.27	1.73	1.92	2.02	2.09	2.13	2.21	2.27	2.30	2.33	2.34
1.99	0.00	0.00	0.00	0.47	1.22	1.67	1.86	1.97	2.03	2.08	2.16	2.22	2.25	2.27	2.29
2.00	0.00	0.00	0.00	0.43	1.17	1.62	1.81	1.91	1.98	2.03	2.10	2.16	2.19	2.22	2.23
2.01	0.00	0.00	0.00	0.39	1.12	1.57	1.76	1.86	1.93	1.97	2.05	2.11	2.14	2.17	2.18
2.02	0.00	0.00	0.00	0.36	1.07	1.52	1.71	1.81	1.87	1.92	2.00	2.06	2.09	2.11	2.13
2.03	0.00	0.00	0.00	0.32	1.03	1.47	1.66	1.76	1.82	1.87	1.95	2.01	2.04	2.06	2.08
2.04	0.00	0.00	0.00	0.29	0.98	1.42	1.61	1.71	1.77	1.82	1.90	1.96	1.99	2.01	2.03
2.05	0.00	0.00	0.00	0.26	0.94	1.37	1.56	1.66	1.73	1.77	1.85	1.91	1.94	1.96	1.98
2.06	0.00	0.00	0.00	0.23	0.90	1.33	1.51	1.61	1.68	1.72	1.80	1.86	1.89	1.92	1.93
2.07	0.00	0.00	0.00	0.21	0.86	1.28	1.47	1.57	1.63	1.68	1.76	1.81	1.84	1.87	1.88
2.08	0.00	0.00	0.00	0.18	0.82	1.24	1.42	1.52	1.59	1.63	1.71	1.77	1.79	1.82	1.84
2.09	0.00	0.00	0.00	0.16	0.78	1.20	1.38	1.48	1.54	1.59	1.66	1.72	1.75	1.78	1.79
2.10	0.00	0.00	0.00	0.14	0.74	1.16	1.34	1.44	1.50	1.54	1.62	1.68	1.71	1.73	1.75
2.11	0.00	0.00	0.00	0.12	0.71	1.12	1.30	1.39	1.46	1.50	1.58	1.63	1.66	1.69	1.70
2.12	0.00	0.00	0.00	0.10	0.67	1.08	1.26	1.35	1.42	1.46	1.54	1.59	1.62	1.65	1.66
2.13	0.00	0.00	0.00	0.08	0.64	1.04	1.22	1.31	1.38	1.42	1.50	1.55	1.58	1.61	1.62
2.14	0.00	0.00	0.00	0.07	0.61	1.00	1.18	1.28	1.34	1.38	1.46	1.51	1.54	1.57	1.58
2.15	0.00	0.00	0.00	0.06	0.58	0.97	1.14	1.24	1.30	1.34	1.42	1.47	1.50	1.53	1.54
2.16	0.00	0.00	0.00	0.05	0.55	0.93	1.10	1.20	1.26	1.30	1.38	1.43	1.46	1.49	1.50
2.17	0.00	0.00	0.00	0.04	0.52	0.90	1.07	1.16	1.22	1.27	1.34	1.40	1.42	1.45	1.46
2.18	0.00	0.00	0.00	0.03	0.49	0.87	1.03	1.13	1.19	1.23	1.30	1.36	1.39	1.41	1.42
2.19	0.00	0.00	0.00	0.02	0.46	0.83	1.00	1.09	1.15	1.20	1.27	1.32	1.35	1.38	1.39
2.20	0.000	0.000	0.000	0.015	0.437	0.803	0.968	1.061	1.120	1.061	1.233	1.287	1.314	1.340	1.352
2.21	0.000	0.000	0.000	0.010	0.413	0.772	0.936	1.028	1.087	1.128	1.199	1.253	1.279	1.305	1.318
2.22	0.000	0.000	0.000	0.006	0.389	0.734	0.905	0.996	1.054	1.095	1.166	1.219	1.245	1.271	1.284
2.23	0.000	0.000	0.000	0.003	0.366	0.715	0.874	0.965	1.023	1.063	1.134	1.186	1.212	1.238	1.250
2.24	0.000	0.000	0.000	0.002	0.345	0.687	0.845	0.935	0.992	1.032	1.102	1.154	1.180	1.205	1.218
2.25	0.000	0.000	0.000	0.001	0.324	0.660	0.816	0.905	0.962	1.002	1.071	1.123	1.148	1.173	1.186
2.26	0.000	0.000	0.000	0.000	0.304	0.634	0.789	0.876	0.933	0.972	1.041	1.092	1.117	1.142	1.155
2.27	0.000	0.000	0.000	0.000	0.285	0.609	0.762	0.848	0.904	0.943	1.011	1.062	1.087	1.112	1.124
2.28	0.000	0.000	0.000	0.000	0.267	0.585	0.735	0.821	0.876	0.915	0.982	1.033	1.058	1.082	1.095
2.29	0.000	0.000	0.000	0.000	0.250	0.561	0.710	0.794	0.849	0.887	0.954	1.004	1.029	1.053	1.065

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
2.30	0.000	0.000	0.000	0.000	0.233	0.538	0.685	0.769	0.823	0.861	0.927	0.977	1.001	1.025	1.037
2.31	0.000	0.000	0.000	0.000	0.218	0.516	0.661	0.743	0.797	0.834	0.900	0.949	0.974	0.998	1.009
2.32	0.000	0.000	0.000	0.000	0.203	0.495	0.637	0.719	0.772	0.809	0.874	0.923	0.947	0.971	0.982
2.33	0.000	0.000	0.000	0.000	0.189	0.474	0.614	0.695	0.748	0.784	0.848	0.897	0.921	0.944	0.956
2.34	0.000	0.000	0.000	0.000	0.175	0.454	0.592	0.672	0.724	0.760	0.824	0.872	0.895	0.919	0.930
2.35	0.000	0.000	0.000	0.000	0.163	0.435	0.571	0.650	0.701	0.736	0.799	0.847	0.870	0.893	0.905
2.36	0.000	0.000	0.000	0.000	0.151	0.416	0.550	0.628	0.678	0.714	0.776	0.823	0.846	0.869	0.880
2.37	0.000	0.000	0.000	0.000	0.139	0.398	0.530	0.606	0.656	0.691	0.753	0.799	0.822	0.845	0.856
2.38	0.000	0.000	0.000	0.000	0.128	0.381	0.510	0.586	0.635	0.670	0.730	0.777	0.799	0.822	0.833
2.39	0.000	0.000	0.000	0.000	0.118	0.364	0.491	0.566	0.614	0.648	0.709	0.754	0.777	0.799	0.810
2.40	0.000	0.000	0.000	0.000	0.109	0.348	0.473	0.546	0.594	0.628	0.687	0.732	0.755	0.777	0.787
2.41	0.000	0.000	0.000	0.000	0.100	0.332	0.455	0.527	0.575	0.608	0.667	0.711	0.733	0.755	0.766
2.42	0.000	0.000	0.000	0.000	0.091	0.317	0.437	0.509	0.555	0.588	0.646	0.691	0.712	0.734	0.744
2.43	0.000	0.000	0.000	0.000	0.083	0.302	0.421	0.491	0.537	0.569	0.627	0.670	0.692	0.713	0.724
2.44	0.000	0.000	0.000	0.000	0.076	0.288	0.404	0.474	0.519	0.551	0.608	0.651	0.672	0.693	0.703
2.45	0.000	0.000	0.000	0.000	0.069	0.275	0.389	0.457	0.501	0.533	0.589	0.632	0.653	0.673	0.684
2.46	0.000	0.000	0.000	0.000	0.063	0.262	0.373	0.440	0.484	0.516	0.571	0.613	0.634	0.654	0.664
2.47	0.000	0.000	0.000	0.000	0.057	0.249	0.359	0.425	0.468	0.499	0.553	0.595	0.615	0.636	0.646
2.48	0.000	0.000	0.000	0.000	0.051	0.237	0.345	0.409	0.452	0.482	0.536	0.577	0.597	0.617	0.627
2.49	0.000	0.000	0.000	0.000	0.046	0.226	0.331	0.394	0.436	0.466	0.519	0.560	0.580	0.600	0.609
2.50	0.000	0.000	0.000	0.000	0.041	0.214	0.317	0.380	0.421	0.451	0.503	0.543	0.563	0.582	0.592
2.51	0.000	0.000	0.000	0.000	0.037	0.204	0.305	0.366	0.407	0.436	0.487	0.527	0.546	0.565	0.575
2.52	0.000	0.000	0.000	0.000	0.033	0.193	0.292	0.352	0.392	0.421	0.472	0.511	0.530	0.549	0.559
2.53	0.000	0.000	0.000	0.000	0.029	0.184	0.280	0.339	0.379	0.407	0.457	0.495	0.514	0.533	0.542
2.54	0.000	0.000	0.000	0.000	0.026	0.174	0.268	0.326	0.365	0.393	0.442	0.480	0.499	0.517	0.527
2.55	0.000	0.000	0.000	0.000	0.023	0.165	0.257	0.314	0.352	0.379	0.428	0.465	0.484	0.502	0.511
2.56	0.000	0.000	0.000	0.000	0.020	0.156	0.246	0.302	0.340	0.366	0.414	0.451	0.469	0.487	0.496
2.57	0.000	0.000	0.000	0.000	0.017	0.148	0.236	0.291	0.327	0.354	0.401	0.437	0.455	0.473	0.482
2.58	0.000	0.000	0.000	0.000	0.015	0.140	0.226	0.279	0.316	0.341	0.388	0.424	0.441	0.459	0.468
2.59	0.000	0.000	0.000	0.000	0.013	0.133	0.216	0.269	0.304	0.330	0.375	0.410	0.428	0.445	0.454
2.60	0.000	0.000	0.000	0.000	0.011	0.125	0.207	0.258	0.293	0.318	0.363	0.398	0.415	0.432	0.441
2.61	0.000	0.000	0.000	0.000	0.009	0.118	0.198	0.248	0.282	0.307	0.351	0.385	0.402	0.419	0.428
2.62	0.000	0.000	0.000	0.000	0.008	0.112	0.189	0.238	0.272	0.296	0.339	0.373	0.390	0.406	0.451
2.63	0.000	0.000	0.000	0.000	0.007	0.105	0.181	0.229	0.262	0.285	0.328	0.361	0.378	0.394	0.402
2.64	0.000	0.000	0.000	0.000	0.006	0.099	0.172	0.220	0.252	0.275	0.317	0.350	0.366	0.382	0.390
2.65	0.000	0.000	0.000	0.000	0.005	0.094	0.165	0.211	0.242	0.265	0.307	0.339	0.355	0.371	0.379
2.66	0.000	0.000	0.000	0.000	0.004	0.088	0.157	0.202	0.233	0.256	0.296	0.328	0.344	0.359	0.367
2.67	0.000	0.000	0.000	0.000	0.003	0.083	0.150	0.194	0.224	0.246	0.286	0.317	0.333	0.348	0.356
2.68	0.000	0.000	0.000	0.000	0.002	0.078	0.143	0.186	0.216	0.237	0.277	0.307	0.322	0.338	0.345
2.69	0.000	0.000	0.000	0.000	0.002	0.073	0.136	0.179	0.208	0.229	0.267	0.297	0.312	0.327	0.335

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
2.70	0.000	0.000	0.000	0.000	0.001	0.069	0.130	0.171	0.200	0.220	0.258	0.288	0.302	0.317	0.325
2.71	0.000	0.000	0.000	0.000	0.001	0.064	0.124	0.164	0.192	0.212	0.249	0.278	0.293	0.307	0.315
2.72	0.000	0.000	0.000	0.000	0.001	0.060	0.118	0.157	0.184	0.204	0.241	0.269	0.283	0.298	0.305
2.73	0.000	0.000	0.000	0.000	0.001	0.057	0.112	0.151	0.177	0.197	0.232	0.260	0.274	0.288	0.296
2.74	0.000	0.000	0.000	0.000	0.000	0.053	0.107	0.144	0.170	0.189	0.224	0.252	0.266	0.279	0.286
2.75	0.000	0.000	0.000	0.000	0.000	0.049	0.102	0.138	0.163	0.182	0.216	0.243	0.257	0.271	0.277
2.76	0.000	0.000	0.000	0.000	0.000	0.046	0.097	0.132	0.157	0.175	0.209	0.235	0.249	0.262	0.269
2.77	0.000	0.000	0.000	0.000	0.000	0.043	0.092	0.126	0.151	0.168	0.201	0.227	0.241	0.254	0.260
2.78	0.000	0.000	0.000	0.000	0.000	0.040	0.087	0.121	0.145	0.162	0.194	0.220	0.223	0.246	0.252
2.79	0.000	0.000	0.000	0.000	0.000	0.037	0.083	0.115	0.139	0.156	0.187	0.212	0.225	0.238	0.244
2.80	0.000	0.000	0.000	0.000	0.000	0.035	0.079	0.110	0.133	0.150	0.181	0.205	0.218	0.230	0.237
2.81	0.000	0.000	0.000	0.000	0.000	0.032	0.075	0.105	0.128	0.144	0.174	0.198	0.211	0.223	0.229
2.82	0.000	0.000	0.000	0.000	0.000	0.030	0.071	0.101	0.122	0.138	0.168	0.192	0.204	0.216	0.222
2.83	0.000	0.000	0.000	0.000	0.000	0.028	0.067	0.096	0.117	0.133	0.162	0.185	0.197	0.209	0.215
2.84	0.000	0.000	0.000	0.000	0.000	0.026	0.064	0.092	0.112	0.128	0.156	0.179	0.190	0.202	0.208
2.85	0.000	0.000	0.000	0.000	0.000	0.024	0.060	0.088	0.108	0.122	0.150	0.173	0.184	0.195	0.201
2.86	0.000	0.000	0.000	0.000	0.000	0.022	0.057	0.084	0.103	0.118	0.145	0.167	0.178	0.189	0.195
2.87	0.000	0.000	0.000	0.000	0.000	0.020	0.054	0.080	0.099	0.113	0.139	0.161	0.172	0.183	0.188
2.88	0.000	0.000	0.000	0.000	0.000	0.019	0.051	0.076	0.094	0.108	0.134	0.155	0.166	0.177	0.182
2.89	0.000	0.000	0.000	0.000	0.000	0.017	0.048	0.073	0.090	0.104	0.129	0.150	0.160	0.171	0.176
2.90	0.000	0.000	0.000	0.000	0.000	0.016	0.046	0.069	0.087	0.100	0.125	0.145	0.155	0.165	0.171
2.91	0.000	0.000	0.000	0.000	0.000	0.015	0.043	0.066	0.083	0.096	0.120	0.140	0.150	0.160	0.165
2.92	0.000	0.000	0.000	0.000	0.000	0.013	0.041	0.063	0.079	0.092	0.115	0.135	0.145	0.155	0.160
2.93	0.000	0.000	0.000	0.000	0.000	0.012	0.038	0.060	0.076	0.088	0.111	0.130	0.140	0.149	0.154
2.94	0.000	0.000	0.000	0.000	0.000	0.011	0.036	0.057	0.072	0.084	0.107	0.125	0.135	0.144	0.149
2.95	0.000	0.000	0.000	0.000	0.000	0.010	0.034	0.054	0.069	0.081	0.103	0.121	0.130	0.140	0.144
2.96	0.000	0.000	0.000	0.000	0.000	0.009	0.032	0.051	0.066	0.077	0.099	0.117	0.126	0.135	0.140
2.97	0.000	0.000	0.000	0.000	0.000	0.009	0.030	0.049	0.063	0.074	0.095	0.112	0.121	0.130	0.135
2.98	0.000	0.000	0.000	0.000	0.000	0.008	0.028	0.046	0.060	0.071	0.091	0.108	0.117	0.126	0.130
2.99	0.000	0.000	0.000	0.000	0.000	0.007	0.027	0.044	0.057	0.068	0.088	0.104	0.113	0.122	0.126
3.00	0.000	0.000	0.000	0.000	0.000	0.006	0.025	0.042	0.055	0.065	0.084	0.101	0.109	0.118	0.122
3.01	0.000	0.000	0.000	0.000	0.000	0.006	0.024	0.040	0.052	0.062	0.081	0.097	0.105	0.113	0.118
3.02	0.000	0.000	0.000	0.000	0.000	0.005	0.022	0.038	0.050	0.059	0.078	0.093	0.101	0.110	0.114
3.03	0.000	0.000	0.000	0.000	0.000	0.005	0.021	0.036	0.048	0.057	0.075	0.090	0.098	0.106	0.110
3.04	0.000	0.000	0.000	0.000	0.000	0.004	0.019	0.034	0.045	0.054	0.072	0.087	0.094	0.102	0.106
3.05	0.000	0.000	0.000	0.000	0.000	0.004	0.018	0.032	0.043	0.052	0.069	0.083	0.091	0.099	0.103
3.06	0.000	0.000	0.000	0.000	0.000	0.003	0.017	0.030	0.041	0.050	0.066	0.080	0.088	0.095	0.099
3.07	0.000	0.000	0.000	0.000	0.000	0.003	0.016	0.029	0.039	0.047	0.064	0.077	0.085	0.092	0.096
3.08	0.000	0.000	0.000	0.000	0.000	0.003	0.015	0.027	0.037	0.045	0.061	0.074	0.081	0.089	0.092
3.09	0.000	0.000	0.000	0.000	0.000	0.002	0.014	0.026	0.036	0.043	0.059	0.072	0.079	0.086	0.089

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
3.10	0.000	0.000	0.000	0.000	0.000	0.002	0.013	0.024	0.034	0.041	0.056	0.069	0.076	0.083	0.086
3.11	0.000	0.000	0.000	0.000	0.000	0.002	0.012	0.023	0.032	0.039	0.054	0.066	0.073	0.080	0.083
3.12	0.000	0.000	0.000	0.000	0.000	0.002	0.011	0.022	0.031	0.038	0.052	0.064	0.070	0.077	0.080
3.13	0.000	0.000	0.000	0.000	0.000	0.002	0.011	0.021	0.029	0.036	0.050	0.061	0.068	0.074	0.077
3.14	0.000	0.000	0.000	0.000	0.000	0.001	0.010	0.019	0.028	0.034	0.048	0.059	0.065	0.071	0.075
3.15	0.000	0.000	0.000	0.000	0.000	0.001	0.009	0.018	0.026	0.033	0.046	0.057	0.063	0.069	0.072
3.16	0.000	0.000	0.000	0.000	0.000	0.001	0.009	0.017	0.025	0.031	0.044	0.055	0.060	0.066	0.069
3.17	0.000	0.000	0.000	0.000	0.000	0.001	0.008	0.016	0.024	0.030	0.042	0.053	0.058	0.064	0.067
3.18	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.015	0.022	0.028	0.040	0.050	0.056	0.062	0.065
3.19	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.015	0.021	0.027	0.038	0.049	0.054	0.059	0.062
3.20	0.000	0.000	0.000	0.000	0.000	0.001	0.006	0.014	0.020	0.026	0.037	0.047	0.052	0.057	0.060
3.21	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.013	0.019	0.024	0.035	0.045	0.050	0.055	0.058
3.22	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.012	0.018	0.023	0.034	0.043	0.048	0.053	0.056
3.23	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.011	0.017	0.022	0.032	0.041	0.046	0.051	0.054
3.24	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.011	0.016	0.021	0.031	0.040	0.044	0.049	0.052
3.25	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.010	0.015	0.020	0.030	0.038	0.043	0.048	0.050
3.26	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.015	0.019	0.028	0.037	0.041	0.046	0.048
3.27	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.014	0.018	0.027	0.035	0.040	0.044	0.046
3.28	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.008	0.013	0.017	0.026	0.034	0.038	0.042	0.045
3.29	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.008	0.012	0.016	0.025	0.032	0.037	0.041	0.043
3.30	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.007	0.012	0.015	0.024	0.031	0.035	0.039	0.042
3.31	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.007	0.011	0.015	0.023	0.030	0.034	0.038	0.040
3.32	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.010	0.014	0.022	0.029	0.032	0.036	0.038
3.33	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.010	0.013	0.021	0.027	0.031	0.035	0.037
3.34	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.009	0.013	0.020	0.026	0.030	0.034	0.036
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.009	0.012	0.019	0.025	0.029	0.032	0.034
3.36	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.008	0.011	0.018	0.024	0.028	0.031	0.033
3.37	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.008	0.011	0.017	0.023	0.026	0.030	0.032
3.38	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.007	0.010	0.016	0.022	0.025	0.029	0.031
3.39	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.007	0.010	0.016	0.021	0.024	0.028	0.029
3.40	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.004	0.007	0.009	0.015	0.020	0.023	0.027	0.028
3.41	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.006	0.009	0.014	0.020	0.022	0.026	0.027
3.42	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.006	0.008	0.014	0.019	0.022	0.025	0.026
3.43	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.008	0.013	0.018	0.021	0.024	0.025
3.44	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.012	0.017	0.020	0.023	0.024
3.45	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.012	0.016	0.019	0.022	0.023
3.46	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.007	0.011	0.016	0.018	0.021	0.022
3.47	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.011	0.015	0.018	0.020	0.022
3.48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.010	0.014	0.017	0.019	0.021
3.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.005	0.010	0.014	0.016	0.019	0.020

[1]Values tabulated are read in percent.

Table B-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Standard Deviation Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	20	25	30	35	50	75	100	150	200
3.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.005	0.009	0.013	0.015	0.018	0.019
3.51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.005	0.009	0.013	0.015	0.017	0.018
3.52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.005	0.008	0.012	0.014	0.016	0.018
3.53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.008	0.011	0.014	0.016	0.017
3.54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.008	0.011	0.013	0.015	0.016
3.55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.007	0.011	0.012	0.015	0.016
3.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.007	0.010	0.012	0.014	0.015
3.57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.006	0.010	0.011	0.013	0.014
3.58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.006	0.009	0.011	0.013	0.014
3.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.006	0.009	0.010	0.012	0.013
3.60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.006	0.008	0.010	0.012	0.013
3.61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.008	0.010	0.011	0.012
3.62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.008	0.009	0.011	0.012
3.63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.007	0.009	0.010	0.011
3.64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.007	0.008	0.010	0.011
3.65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.007	0.008	0.010	0.010
3.66	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.008	0.009	0.010
3.67	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.009	0.010
3.68	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.008	0.009
3.69	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.007	0.008	0.009
3.70	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.006	0.008	0.008
3.71	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.005	0.006	0.007	0.008
3.72	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.005	0.006	0.007	0.008
3.73	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.005	0.006	0.007	0.007
3.74	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.004	0.005	0.006	0.007
3.75	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.005	0.006	0.007
3.76	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.005	0.006	0.007
3.77	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.005	0.006	0.006
3.78	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.004	0.005	0.006
3.79	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.006
3.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.006
3.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.005
3.82	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.005
3.83	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.004	0.005
3.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.003	0.004	0.005
3.85	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.004	0.004
3.86	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.004
3.87	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.004
3.88	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.003	0.004
3.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.003	0.004
3.90	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.003	0.004

[1]Values tabulated are read in percent.

Table B-6
Values of F for Maximum Standard Deviation (MSD)

Sample size	Acceptable Quality Levels (in percent nonconforming)											
	T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
3									.436	.453	.475	.502
4							.338	.353	.374	.399	.432	.472
5					.281	.294	.308	.323	.346	.372	.408	.452
7		.224	.231	.242	.253	.266	.280	.295	.318	.345	.381	.425
10	.200	.206	.214	.224	.235	.247	.261	.275	.298	.324	.359	.403
15	.188	.195	.202	.212	.222	.235	.248	.262	.284	.309	.344	.386
20	.183	.190	.197	.206	.217	.229	.242	.256	.277	.302	.336	.377
25	.180	.187	.194	.203	.213	.225	.238	.252	.273	.298	.331	.372
30	.179	.185	.192	.201	.211	.223	.236	.249	.271	.295	.329	.369
35	.176	.182	.189	.198	.208	.220	.232	.246	.267	.291	.324	.364
50	.172	.178	.185	.194	.204	.215	.227	.241	.261	.285	.317	.357
75	.168	.174	.181	.190	.199	.211	.223	.236	.256	.279	.311	.349
100	.167	.173	.179	.188	.198	.209	.220	.233	.253	.276	.308	.346
150	.164	.170	.176	.185	.195	.206	.217	.230	.250	.273	.304	.341
200	.164	.168	.176	.185	.194	.205	.217	.230	.249	.272	.303	.340

The MSD may be obtained by multiplying the factor F by the difference between the upper specification limit U and lower specification limit L. The formula is MSD = F (U – L). The MSD serves as a guide for the magnitude of the estimate of lot standard deviation when using plans for the double specification limit case, based on the estimate of lot standard deviation of unknown variability. The estimate of lot standard deviation, if it is less than the MSD, helps to insure, but does not guarantee, lot acceptability.

NOTE: There is a corresponding acceptability constant in Table B-1 for each value of F. For reduced inspection, find the acceptability constant of Table B-2 in Table B-1 and use the corresponding value of F.

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

APPENDIX B
Definitions

Symbol	Read	Definition
n		Sample size for a single lot.
$\bar{X}$	X bar	Sample mean. Arithmetic mean of sample measurements from a single lot. $\bar{X} = \frac{\Sigma X}{n}$
s		Estimate of lot standard deviation. Standard deviation of sample measurements from a single lot. (See Examples in Section B.) $s = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}{n-1}}$
U		Upper specification limit.
L		Lower specification limit.
k		The acceptability constant given in Tables B-1 and B-2.
Q_U	Q sub U	Quality index for use with Table B-5.
Q_L	Q sub L	Quality index for use with Table B-5.
p_U	p sub U	Sample estimate of the lot percent nonconforming above U from Table B-5.
p_L	p sub L	Sample estimate of the lot percent nonconforming below L from Table B-5.
p		Total sample estimate of the lot percent nonconforming $p = p_U + p_L$.
M		Maximum allowable percent nonconforming for sample estimates given in Tables B-3 and B-4.
M_U	M sub U	Maximum allowable percent nonconforming above U given in Tables B-3 and B-4. (For use when different AQL values for U and L are specified.)
M_L	M sub L	Maximum allowable percent nonconforming below L given in Tables B-3 and B-4. (For use when different AQL values for U and L are specified.)
$\bar{p}$	p bar	Sample estimate of the process percent nonconforming, i.e., the estimated process average.
$\bar{p}_U$	p bar sub U	The estimated process average for an upper specification limit.
$\bar{p}_L$	p bar sub L	The estimated process average for a lower specification limit.
F		A factor used in determining the Maximum Standard Deviation (MSD). The F values are given in Table B-6.
>	Greater than	Greater than.
<	Less than	Less than.
Σ	Sum of	Sum of.
T		AQL symbol denoting plan used exclusively on tightened inspection (provides identification of appropriate OC curve).

SECTION C
VARIABILITY UNKNOWN—RANGE METHOD

Part I
SINGLE SPECIFICATION LIMIT

C1. SAMPLING PLAN FOR SINGLE SPECIFICATION LIMIT

This part of the Standard describes the procedures for use with plans for a single specification limit when variability of the lot with respect to the quality characteristic is unknown and the range method is used. The acceptability criterion is given in two equivalent forms. These are identified as Form 1 and Form 2.

C1.1 Use of Sampling Plans. To determine whether the lot meets the acceptability criterion with respect to a particular quality characteristic and AQL value, the applicable sampling plan shall be used in accordance with the provisions of Section A, General Description of the Sampling Plans, and those in this part of the Standard.

C1.2 Drawing of Samples. All samples shall be drawn in accordance with paragraph A7.2.

C1.3 Determination of Sample Size Code Letter. The sample size code letter shall be selected from Table A-2 in accordance with paragraph A7.1.

C2. SELECTING THE SAMPLE PLAN WHEN FORM 1 IS USED

C2.1 Master Sampling Tables. The master sampling tables for plans based on variability unknown for a single specification limit when using the range method are Tables C-1 and C-2. Table C-1 is used for normal and tightened inspection and Table C-2 for reduced inspection.

C2.2 Obtaining the Sample Plan. The sampling plan consists of a sample size and an associated acceptability constant.[1] The sampling plan is obtained from Master Table C-1 or C-2.

C2.2.1 Sample Size. The sample size n is shown in the master table corresponding to each sample size code letter.

C2.2.2 Acceptability Constant. The acceptability constant k, corresponding to the sample size mentioned in paragraph C2.2.1, is indicated in the column of the master table corresponding to the applicable AQL value. Table C-1 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table C-2.

C3. LOT-BY-LOT ACCEPTABILITY PROCEDURES WHEN FORM 1 IS USED[2]

C3.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a single specification limit shall be judged by the quantity $(U - \bar{X})/\bar{R}$ or $(\bar{X} - L)/\bar{R}$.

C3.2 Computation. The following quantity shall be computed: $(U - \bar{X})/\bar{R}$ or $(\bar{X} - L)/\bar{R}$, depending on whether the specification limit is an upper or a lower limit, where

U is the upper specification limit,
L is the lower specification limit,
$\bar{X}$ is the sample mean, and
$\bar{R}$ is the average range of the sample.

In this Standard, $\bar{R}$ is the average range of subgroup ranges. Each of the subgroups consists of 5 measurements, except for those plans with sample size 3, 4, or 7 in which case the subgroup size is the same as the sample size and the sample range is used as $\bar{R}$. In computing $\bar{R}$, the order of the sample measurements as made must be retained. Subgroups of consecutive measurements must be formed and the range of each subgroup obtained. $\bar{R}$ is the average of the individual subgroup ranges.

C3.3 Acceptability Criteria. Compare the quantity $(U - \bar{X})/\bar{R}$ or $(\bar{X} - L)/\bar{R}$ with the acceptability constant k. If $(U - \bar{X})/\bar{R}$ or $(\bar{X} - L)/\bar{R}$ is equal to or greater than k, the lot meets the acceptability criterion; if $(U - \bar{X})/\bar{R}$ or $(\bar{X} - L)/\bar{R}$ is less than k or negative, then the lot does not meet the acceptability criterion.

C4. SUMMARY FOR OPERATION OF SAMPLING PLAN WHEN FORM 1 IS USED

The following steps summarize the procedures to be followed:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Obtain plan from Master Table C-1 or C-2 by selecting the sample size n and the acceptability constant k.

[1]See Appendix C for definitions of all symbols used in the sampling plans based on variability unknown—range method.

[2]See Example C-1 for a complete example of this procedure.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic for each unit of the sample.

(4) Compute the sample mean $\bar{X}$ and the average range of the sample $\bar{R}$, and also compute the quantity $(U-\bar{X})/\bar{R}$ for an upper specification limit U or the quantity $(\bar{X}-L)/\bar{R}$ for a lower specification limit L.

(5) If the quantity $(U-\bar{X})/\bar{R}$ or $(\bar{X}-L)/\bar{R}$ is equal to or greater than k, the lot meets the acceptability criterion; if $(U-\bar{X})/\bar{R}$ or $(\bar{X}-L)/\bar{R}$ is less than k or negative, then the lot does not meet the acceptability criterion.

C5. SELECTING THE SAMPLING PLAN WHEN FORM 2 IS USED

C5.1 Master Sampling Tables. The master sampling tables for plans based on variability unknown for a single specification limit when using the range method are Tables C-3 and C-4 of Part II. Table C-3 is used for normal and tightened inspection and Table C-4 for reduced inspection.

C5.2 Obtaining the Sampling Plan. The sampling plan consists of a sample size and an associated maximum allowable percent nonconforming. The sampling plan is obtained from Master Table C-3 or C-4.

C5.2.1 Sample Size. The sample size n is shown in the master table corresponding to each sample size code letter.

C5.2.2 Maximum Allowable Percent Nonconforming. The maximum allowable percent nonconforming M for sample estimates corresponding to the sample size mentioned in paragraphs C5.2.1 is indicated in the column of the master table corresponding to the applicable AQL value. Table C-3 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table C-4.

C6. LOT-BY-LOT ACCEPTABILITY PROCEDURES WHEN FORM 2 IS USED[3]

C6.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a single specification limit shall be judged by the percent of nonconforming product outside the upper or lower specification limit. The percentage of nonconforming product is estimated by entering Table C-5 with the quality index and the sample size.

C6.2 Computation of Quality Index. The quality index $Q_U = (U-\bar{X})c/\bar{R}$ shall be computed if the specification limit is an upper limit U, or $Q_L = (\bar{X}-L)c/\bar{R}$ if it is a lower limit L. The quantities, $\bar{X}$ and $\bar{R}$, are the sample mean and average range of the sample, respectively. The computation of $\bar{R}$ is explained in paragraph C3.2. The factor c is provided in Master Tables C-3 and C-4 corresponding to the sample size code letter.

C6.3 Estimate of Percent Nonconforming in Lot. The quality of a lot shall be expressed by p_U, the estimated percent nonconforming in the lot above the upper specification limit, or by p_L, the estimated percent nonconforming below the lower specification limit. The estimated percent nonconforming p_U or p_L is obtained by entering Table C-5 with Q_U or Q_L and the appropriate sample size.

C6.4 Acceptability Criterion. Compare the estimated lot percent nonconforming p_U or p_L with the maximum allowable percent nonconforming M. If p_U or p_L is equal to or less than M, the lot meets the acceptability criterion; if p_U or p_L is greater than M or if Q_U or Q_L is negative, then the lot does not meet the acceptability criterion.

C7. SUMMARY OF OPERATION OF SAMPLING PLAN WHEN FORM 2 IS USED

The following steps summarize the procedures to be followed:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Obtain plan from Master Table C-3 or C-4 by selecting the sample size n, the factor c, and the maximum allowable percent nonconforming M.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit of the sample.

[3]See Example C-2 for a complete example of this procedure.

(4) Compute the sample mean $\bar{X}$ and the average range of the sample $\bar{R}$.

(5) Compute the quality index $Q_U = (U - \bar{X})c/\bar{R}$ if the upper specification limit U is specified, or $Q_L = (\bar{X} - L)c/\bar{R}$ if the lower specification limit L is specified.

(6) Determine the estimated lot percent nonconforming p_L or p_U from Table C-5.

(7) If the estimated lot percent nonconforming p_L or p_U is equal to or less than the maximum allowable percent nonconforming M, the lot meets the acceptability criterion; if p_L or p_U is greater than M or if Q_U or Q_L is negative, then the lot does not meet the acceptability criterion.

EXAMPLE C-1

Example of Calculations

Single Specification Limit—Form 1

Variability Unknown—Range Method

Example: The lower specification limit for electrical resistance of a certain electrical component is 620 ohms. A lot of 100 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = .4% is to be used. From Tables A-2 and C-1 it is seen that a sample of size 10 is required. Suppose that values of the sample resistances in the order reading from left to right are as follows:

643, 651, 619, 627, 658, ($R_1 = 658 - 619 = 39$)
670, 673, 641, 638, 650, ($R_2 = 673 - 638 = 35$)

and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size n	10	
2	Sum of Measurements: ΣX	6470	
3	Sample Mean ($\bar{X}$): $\Sigma X/n$	647	6470/10
4	Average Range ($\bar{R}$): ΣR/no. of subgroups	37	(39 + 35)/2
5	Specification Limit (Lower): L	620	
6	The quantity: $(\bar{X} - L)/\bar{R}$	.730	(647 – 620)/37
7	Acceptability Constant: k	.811	See Table C-1
8	Acceptability Criterion: Compare $(\bar{X} - L)/\bar{R}$ with k	.730 < .811	See Para. C3.3

The lot does not meet the acceptability criterion, since $(\bar{X} - L)/\bar{R}$ is less than k.

NOTE: If a single upper specification limit U is given, then compute the quantity $(U - \bar{X})/\bar{R}$ in line 6 and compare it with k; the lot meets the acceptability criterion if $(U - \bar{X})/\bar{R}$ is equal to or greater than k.

EXAMPLE C-2

Example of Calculations

Single Specification Limit—Form 2

Variability Unknown—Range Method

Example: A lower specification limit for electrical resistance of a certain electrical component is 620 ohms. A lot of 100 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = .4% is to be used. From Tables A-2 and C-1 it is seen that a sample of size 10 is required. Suppose the values of the sample resistances in the order reading from left to right are as follows:

643, 651, 619, 627, 658, ($R_1 = 658 - 619 = 39$)
670, 673, 641, 638, 650, ($R_2 = 673 - 638 = 35$)

and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample size n	10	
2	Sum of Measurements: ΣX	6470	
3	Sample Mean $\bar{X}$: $\Sigma X/n$	647	6470/10
4	Average Range $\bar{R}$: ΣR/no. of subgroups	37	(39 + 35)/2
5	Factor c	2.405	See Table C-3
6	Specification Limit (Lower): L	620	
7	Quality Index: $Q_L = (\bar{X} - L)c/\bar{R}$	1.76	(647 – 620)2.405/37
8	Est. of Lot Percent Ncf.: p_L	2.54%	See Table C-5
9	Max. Allowable Percent Ncf.: M	1.14%	See Table C-3
10	Acceptability Criterion: Compare p_L with M	2.54% > 1.14%	See Para. C6.4

The lot does not meet the acceptability criterion, since p_L is greater than M.

NOTE: If a single upper specification limit U is given, then compute the quality index $Q_U = (U - \bar{X})c/\bar{R}$ in line 7 and obtain the estimate of lot percent nonconforming p_U. Compare p_U with M; the lot meets the acceptability criterion, if p_U is equal to or less than M.

Table C-1 Range Method

Master Table for Normal and Tightened Inspection for Plans Based on Variability Unknown
(Single Specification Limit—Form 1)

Sample size code letter	Sample size	Acceptable Quality Levels (normal inspection)											
		T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		k	k	k	k	k	k	k	k	k	k	k	k
B	3	↓	↓	↓	↓	↓	↓	↓	↓	.587	.502	.401	.296
C	4	↓	↓	↓	↓	↓	↓	.651	.598	.525	.450	.364	.276
D	5	↓	↓	↓	↓	↓	.663	.614	.565	.498	.431	.352	.272
E	7	↓	↓	↓	.702	.659	.613	.569	.525	.465	.405	.336	.266
F	10	↓	↓	.916	.863	.811	.755	.703	.650	.579	.507	.424	.341
G	15	1.04	.999	.958	.903	.850	.792	.738	.684	.610	.536	.452	.368
H	25	1.10	1.05	1.01	.951	.896	.835	.779	.723	.647	.571	.484	.398
I	30	1.10	1.06	1.02	.959	.904	.843	.787	.730	.654	.577	.490	.403
J	40	1.13	1.08	1.04	.978	.921	.860	.803	.746	.668	.591	.503	.415
K	60	1.16	1.11	1.06	1.00	.948	.885	.826	.768	.689	.610	.521	.432
L	85	1.17	1.13	1.08	1.02	.962	.899	.839	.780	.701	.621	.530	.441
M	115	1.19	1.14	1.09	1.03	.975	.911	.851	.791	.711	.631	.539	.449
N	175	1.21	1.16	1.11	1.05	.994	.929	.868	.807	.726	.644	.552	.460
P	230	1.21	1.16	1.12	1.06	.996	.931	.870	.809	.728	.646	.553	.462
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00	
		Acceptable Quality Levels (tightened inspection)											

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table C-2

Master Table for Reduced Inspection for Plans Based on Variability Unknown
(Single Specification Limit—Form 1)

Sample size code letter	Sample size	Acceptable Quality Levels										
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
		k	k	k	k	k	k	k	k	k	k	k
B	3	↓	↓	↓	↓	↓	↓	.587	.502	.401	.296	.178
C	3							.587	.502	.401	.296	.178
D	3							.587	.502	.401	.296	.178
E	3							.587	.502	.401	.296	.178
F	4					.651	.598	.525	.450	.364	.276	.176
G	5		↓	↓	.663	.614	.565	.498	.431	.352	.272	.184
H	7	↓	.702	.659	.613	.569	.525	.465	.405	.336	.266	.189
I	10	.916	.863	.811	.755	.703	.650	.579	.507	.424	.341	.252
J	15	.958	.903	.850	.792	.738	.684	.610	.536	.452	.368	.276
K	25	1.01	.951	.896	.835	.779	.723	.647	.571	.484	.398	.305
L	30	1.02	.959	.904	.843	.787	.730	.654	.577	.490	.403	.310
M	35	1.02	.964	.908	.848	.791	.734	.658	.581	.494	.406	.313
N	60	1.06	1.00	.948	.885	.826	.768	.689	.610	.521	.432	.336
P	85	1.08	1.02	.962	.899	.839	.780	.701	.621	.530	.441	.345

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Part II
DOUBLE SPECIFICATION LIMIT

C8. SAMPLING PLAN FOR DOUBLE SPECIFICATION LIMIT

This part of the Standard describes the procedures for use with plans for a double specification limit when variability of the lot with respect to the quality characteristic is unknown and the range method is used.

C8.1 Use of Sampling Plans. To determine whether the lot meets the acceptability criterion with respect to a particular quality characteristic and AQL value(s), the applicable sampling plan shall be used in accordance with the provisions of Section A, General Description of Sampling Plans, and those in this part of the Standard.

C9. SELECTING THE SAMPLING PLAN

A sampling plan for each AQL value shall be selected from Table C-3 or C-4 as follows:

C9.1 Determination of Sample Size Code Letter. The sample size code letter shall be selected from Table A-2 in accordance with paragraph A7.1.

C9.2 Master Sampling Tables. The master sampling tables for plans based on variability unknown for a double specification limit when using the range method are Tables C-3 and C-4. Table C-3 is used for normal and tightened inspection and Table C-4 for reduced inspection.

C9.3 Obtaining Sampling Plan. A sampling plan consists of a sample size and the associated maximum allowable percent nonconforming. The sampling plan to be applied in inspection shall be obtained from Master Table C-3 or C-4.

C9.3.1 Sample Size. The sample size n is shown in the master tables corresponding to each sample size code letter.

C9.3.2 Maximum Allowable Percent Nonconforming. The maximum allowable percent nonconforming for sample estimates of percent nonconforming for the lower, upper, or both specification limits combined, corresponding to the sample size mentioned in paragraph C9.3.1, is shown in the column of the master table corresponding to the applicable AQL value(s). If different AQLs are assigned to each specification limit, designate the maximum allowable percent nonconforming by M_L for the lower limit, and by M_U for the upper limit. If one AQL is assigned to both limits combined, designate the maximum allowable percent nonconforming by M. Table C-3 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table C-4.

C10. DRAWING OF SAMPLES

Samples shall be selected in accordance with paragraph A7.2.

C11. LOT-BY-LOT ACCEPTABILITY PROCEDURES

C11.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a double specification limit shall be judged by the percent of nonconforming product. The percentage of nonconforming product is estimated by entering Table C-5 with the quality index and the sample size.

C11.2 Computation of Quality Indices. The quality indices $Q_U = (U - \bar{X})c/\bar{R}$ and $Q_L = (\bar{X} - L)c/\bar{R}$ shall be computed, where

U is the upper specification limit,
L is the lower specification limit,
c is a factor provided in Tables C-3 and C-4,
$\bar{X}$ is the sample mean, and
$\bar{R}$ is the average range of the sample.

In this Standard, $\bar{R}$ is the average range of the subgroup ranges. Each of the subgroups consists of 5 measurements, except for those plans with sample size 3, 4, or 7 in which case the subgroup size is the same as the sample size and the sample range is used as $\bar{R}$. In computing $\bar{R}$, the order of the sample measurements as made must be retained. Subgroups of consecutive measurements must be formed and the range of each subgroup obtained. $\bar{R}$ is the average of the individual subgroup ranges.

C11.3 Percent Nonconforming in the Lot. The quality of a lot shall be expressed in terms of the lot percent nonconforming. Its estimate will be designated by p_L, p_U, or p. The estimate p_U indicates conformance with respect to the upper specification limit, p_L with respect to the lower specification limit, and p for both specification limits combined. The estimate p_L and p_U shall be determined by entering Table

C-5, respectively with Q_L and Q_U and the sample size. The estimate p shall be determined by adding the corresponding estimated percents nonconforming p_L and p_U found in the table.

C12. ACCEPTABILITY CRITERION AND SUMMARY FOR OPERATION OF SAMPLING PLANS

C12.1 One AQL Value for Both Upper and Lower Specification Limit Combined.

C12.1.1 Acceptability Criterion.[4] Compare the estimated lot percent nonconforming $p = p_U + p_L$ with the maximum allowable percent nonconforming M. If p is equal to or less than M, the lot meets the acceptability criterion; if p is greater than M or if either Q_U or Q_L or both are negative, then the lot does not meet the acceptability criterion.

C12.1.2 Summary for Operation of Sampling Plan. In cases where a single AQL value is established for the upper and lower specification limit combined for a single quality characteristic, the following steps summarize the procedures to be used:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Select plan from Master Table C-3 or C-4. Obtain the sample size n, the factor c, and the maximum allowable percent nonconforming M.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit of the sample.

(4) Compute the sample mean $\bar{X}$ and average range of the sample $\bar{R}$.

(5) Compute the quality indices $Q_U = (U - \bar{X})c/\bar{R}$ and $Q_L = (\bar{X} - L)c/\bar{R}$.

(6) Determine the estimated lot percent nonconforming $p = p_U + p_L$ from Table C-5.

(7) If the estimated lot percent nonconforming p is equal to or less than the maximum allowable percent nonconforming M, the lot meets the acceptability criterion; if p is greater than M or if either Q_U or Q_L or both are negative, then the lot does not meet the acceptability criterion.

C12.2 Different AQL Values for Upper and Lower Specification Limit.

C12.2.1 Acceptability Criteria.[5] Compare the estimated lot percents nonconforming p_L and p_U with the corresponding maximum allowable percents nonconforming M_L and M_U; also compare $p = p_L + p_U$ with the larger of M_L and M_U. If p_L is equal to or less than M_L, p_U is equal to or less than M_U, and p is equal to or less than the larger of M_L and M_U, the lot meets the acceptability criteria; otherwise, the lot does not meet the acceptability criteria. If either Q_L or Q_U or both are negative, then the lot does not meet the acceptability criteria.

C12.2.2 Summary for Operation of Sampling Plan. In cases where a different AQL value is established for the upper and lower specification limit for a single quality characteristic, the following steps summarize the procedures to be used:

(1) Determine the sample size code letter from Table A-2 by using the lot size and inspection level.

(2) Select the sampling plan from Master Table C-3 or C-4. Obtain the sample size n, the factor c, and the maximum allowable percent nonconforming M_U and M_L, corresponding to AQL values for the upper and lower specification limits, respectively.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit in the sample.

(4) Compute the sample mean $\bar{X}$ and average range of the sample $\bar{R}$.

(5) Compute the quality indices $Q_U = (U - \bar{X})c/\bar{R}$ and $Q_L = (\bar{X} - L)c/\bar{R}$.

(6) Determine the estimated lot percents nonconforming p_U and p_L, corresponding to the percents nonconforming above the upper and below the lower specification limits. Also determine the combined percent nonconforming $p = p_U + p_L$.

[4]See Example C-3 for a complete example of this procedure.

[5]See Example C-4 for a complete example of this procedure.

(7) If all three of the following conditions:
  (a) p_U is equal to or less than M_U,
  (b) p_L is equal to or less than M_L,
  (c) p is equal to or less than the larger of M_L and M_U,

are satisfied, the lot meets the acceptability criteria; otherwise the lot does not meet the acceptability criteria. If either Q_L or Q_U or both are negative, then the lot does not meet the acceptability criteria.

EXAMPLE C-3

Example of Calculations

Double Specification Limit

Variability Unknown—Average Range Method

One AQL Value for Both Upper and Lower Specification Limit Combined

Example: The specifications for electrical resistance of a certain electrical component is 650.0 ± 340 ohms. A lot of 100 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = .4% is to be used. From Tables A-2 and C-3 it is seen that a sample of size 10 is required. Suppose the values of the sample resistance in the order reading from left to right are as follows:

643, 651, 619, 627, 658, ($R_1 = 658 - 619 = 39$)
670, 673, 641, 638, 650, ($R_2 = 673 - 638 = 35$)

and compliance with the acceptability criterion is to be determined.

Lot	Information Needed	Value Obtained	Explanation
1	Sample Size: n	10	
2	Sum of Measurements: ΣX	6470	
3	Sample Mean $\bar{X}$: $\Sigma X/n$	647	6470/10
4	Average Range $\bar{R}$: ΣR/no. of subgroups	37	(39 + 35)/2
5	Factor c	2.405	See Table C-3
6	Upper Specification Limit: U	680	
7	Lower Specification Limit: L	620	
8	Quality Index: $Q_U = (U - \bar{X})c/\bar{R}$	2.15	(680 – 647)2.405/37
9	Quality Index: $Q_L = (\bar{X} - L)c/\bar{R}$	1.76	(647 – 620)2.405/37
10	Est. of Lot Percent Ncf. above U: p_U	.35%	See Table C-5
11	Est. of Lot Percent Ncf. below L: p_L	2.54%	See Table C-5
12	Total Est. Percent Ncf. in Lot: $p = p_U + p_L$	2.89%	.35% + 2.54%
13	Max. Allowable Percent Ncf.: M	1.14%	See Table C-3
14	Acceptability Criterion: Compare $p = p_U + p_L$ with M	2.89% > 1.14%	See Para. C12.1.2(7)

The lot does not meet the acceptability criterion, since $p = p_U + p_L$ is greater than M.

EXAMPLE C-4

Example of Calculations

Double Specification Limit

Variability Unknown—Average Range Method

Different AQL Values for Upper and Lower Specification Limits

Example: The specifications for electrical resistance of a certain electrical component is 650.0 ± 30 ohms. A lot of 100 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 2.5% for the upper and AQL = 1% for the lower specification limit is to be used. From Tables A-2 and C-3 it is seen that a sample of size 10 is required. Suppose the values of the sample resistances in the order reading from left to right are as follows:

643, 651, 619, 627, 658, ($R_1 = 658 - 619 = 39$)
670, 673, 641, 638, 650, ($R_2 = 673 - 638 = 35$)

and compliance with the acceptability criteria is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	10	
2	Sum of Measurements: ΣX	6470	
3	Sample Mean $\bar{X}$: $\Sigma X/n$	647	6470/10
4	Average Range $\bar{R}$: ΣR/no. of subgroups	37	(39 + 35)/2
5	Factor c	2.405	See Table C-3
6	Upper Specification Limit: U	680	
7	Lower Specification Limit: L	620	
8	Quality Index: $Q_U = (U - \bar{X})c/\bar{R}$	2.15	(680 – 647)2.405/37
9	Quality Index: $Q_L = (\bar{X} - L)c/\bar{R}$	1.76	(647 – 620)2.405/37
10	Est. of Lot Percent Ncf. above U: p_U	.35%	See Table C-5
11	Est. of Lot Percent Ncf. below L: p_L	2.54%	See Table C-5
12	Total Est. Percent Ncf. in Lot: $p = p_U + p_L$	2.89%	.35% + 2.54%
13	Max. Allowable Percent Ncf. above U: M_U	7.42%	See Table C-3
14	Max. Allowable Percent Ncf. below L: M_L	3.23%	See Table C-3
15	Acceptability Criteria: (a) Compare p_U with M_U	.35% < 7.42%	See Para. C12.2.2(7)(a)
	(b) Compare p_L with M_L	2.54% < 3.23%	See Para. C12.2.2(7)(b)
	(c) Compare p with M_U	2.89% < 7.42%	See Para. C12.2.2(7)(c)

The lot meets the acceptability criteria, since 15(a), (b), and (c) are satisfied; i.e., $p_U < M_U$, $p_L < M_L$, and $p < M_U$.

Table C-3

Range Method

Master Table for Normal and Tightened Inspection for Plans Based on Variability Unknown
(Double Specification Limit and for Form 2—Single Specification Limit)

Sample size code letter	Sample size	c factor	Acceptable Quality Levels (normal inspection)											
			T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
			M	M	M	M	M	M	M	M	M	M	M	M
B	3	0.910	↓	↓	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69
C	4	2.234	↓	↓	↓	↓	↓	↓	1.53	5.50	10.92	16.45	22.86	29.45
D	5	2.474	↓	↓	↓	↓	↓	1.42	3.44	5.93	9.90	14.47	20.27	26.59
E	7	2.830	↓	↓	↓	.28	.89	1.99	3.46	5.32	8.47	12.35	17.54	23.50
F	10	2.405	↓	↓	.23	.58	1.14	2.05	3.23	4.77	7.42	10.79	15.49	21.06
G	15	2.379	.136	.253	.430	.786	1.30	2.10	3.11	4.44	6.76	9.76	14.09	19.30
H	25	2.358	.214	.336	.506	.827	1.27	1.95	2.82	3.96	5.98	8.65	12.59	17.48
I	30	2.353	.240	.366	.537	.856	1.29	1.96	2.81	3.92	5.88	8.50	12.36	17.19
J	40	2.346	.252	.375	.539	.842	1.25	1.88	2.69	3.73	5.61	8.11	11.84	16.55
K	60	2.339	.244	.356	.504	.781	1.16	1.74	2.47	3.44	5.17	7.54	11.10	15.64
L	85	2.335	.242	.350	.493	.755	1.12	1.67	2.37	3.30	4.97	7.27	10.73	15.17
M	115	2.333	.230	.333	.468	.718	1.06	1.58	2.25	3.14	4.76	6.99	10.37	14.74
N	175	2.331	.210	.303	.427	.655	.972	1.46	2.08	2.93	4.47	6.60	9.89	14.15
P	230	2.330	.215	.308	.432	.661	.976	1.47	2.08	2.92	4.46	6.57	9.84	14.10
			.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00	
			Acceptable Quality Levels (*tightened inspection*)											

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table C-4

Master Table for Reduced Inspection for Plans Based on Variability Unknown
(Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Sample size	c factor	Acceptable Quality Levels (normal inspection)										
			.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
			M	M	M	M	M	M	M	M	M	M	M
B	3	1.910	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69	40.47
C	3	1.910							7.59	18.86	26.94	33.69	40.47
D	3	1.910	↓	↓	↓	↓	↓	↓	7.59	18.86	26.94	33.69	40.47
E	3	1.910							7.59	18.86	26.94	33.69	40.47
F	4	2.234					1.53	5.50	10.92	16.45	22.86	29.45	36.90
G	5	2.474	↓	↓	↓	1.42	3.44	5.93	9.90	14.47	20.27	26.59	33.95
H	7	2.830		.28	.89	1.99	3.46	5.32	8.47	12.35	17.54	23.50	30.66
I	10	2.405	.23	.58	1.14	2.05	3.23	4.77	7.42	10.79	15.49	21.06	27.90
J	15	2.379	.430	.786	1.30	2.10	3.11	4.44	6.76	9.76	14.09	19.30	25.92
K	25	2.358	.506	.827	1.27	1.95	2.82	3.96	5.98	8.65	12.59	17.48	23.79
L	30	2.353	.537	.856	1.29	1.96	2.81	3.92	5.88	8.50	12.36	17.19	23.42
M	35	2.349	.564	.883	1.33	1.98	2.82	3.90	5.85	8.42	12.24	17.03	23.21
N	60	2.339	.504	.781	1.16	1.74	2.47	3.44	5.17	7.54	11.10	15.64	21.63
P	85	2.335	.493	.755	1.12	1.67	2.37	3.30	4.97	7.27	10.73	15.17	21.05

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table C-5

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
0	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
.1	47.24	46.67	46.44	46.29	46.20	46.13	46.08	46.07	46.06	46.05	46.04	46.03	46.03	46.02	46.02
.2	44.46	43.33	42.90	42.60	42.42	42.29	42.19	42.17	42.16	42.15	42.12	42.10	42.10	42.08	42.08
.3	41.63	40.00	39.37	38.95	38.70	38.51	38.38	38.34	38.32	38.31	38.27	38.26	38.24	38.23	38.22
.31	41.35	39.67	39.02	38.59	38.33	38.14	38.00	37.96	37.94	37.93	37.89	37.88	37.86	37.85	37.84
.32	41.06	39.33	38.67	38.23	37.96	37.77	37.63	37.59	37.57	37.55	37.51	37.50	37.48	37.47	37.46
.33	40.77	39.00	38.32	37.87	37.60	37.39	37.25	37.21	37.19	37.18	37.14	37.12	37.11	37.09	37.09
.34	40.49	38.67	37.97	37.51	37.23	37.02	36.88	36.84	36.82	36.80	36.76	36.74	36.73	36.71	36.71
.35	40.20	38.33	37.62	37.15	36.87	36.65	36.50	36.46	36.44	36.43	36.39	36.37	36.36	36.34	36.33
.36	39.91	38.00	37.28	36.79	36.50	36.29	36.13	36.09	36.07	36.05	36.01	35.99	35.97	35.96	35.96
.37	39.62	37.67	36.93	36.43	36.14	35.92	35.76	35.72	35.70	35.68	35.64	35.62	35.61	35.59	35.59
.38	39.33	37.33	36.58	36.07	35.78	35.55	35.39	35.35	35.33	35.31	35.27	35.25	35.24	35.22	35.22
.39	39.03	37.00	36.23	35.72	35.41	35.19	35.02	34.98	34.96	34.94	34.90	34.88	34.87	34.85	34.85
.40	38.74	36.67	35.88	35.36	35.05	34.82	34.66	34.62	34.59	34.58	34.53	34.51	34.49	34.48	34.48
.41	38.45	36.33	35.54	35.01	34.69	34.46	34.29	34.25	34.23	34.21	34.17	34.14	34.12	34.11	34.11
.42	38.15	36.00	35.19	34.65	34.33	34.10	33.93	33.89	33.86	33.85	33.80	33.78	33.77	33.75	33.74
.43	37.85	35.67	34.85	34.30	33.98	33.74	33.57	33.53	33.50	33.48	33.44	33.41	33.39	33.38	33.38
.44	37.56	35.33	34.50	33.95	33.62	33.38	33.21	33.17	33.14	33.12	33.08	33.05	33.03	33.02	33.02
.45	37.26	35.00	34.16	33.60	33.27	33.02	32.85	32.81	32.78	32.76	32.72	32.69	32.67	32.66	32.66
.46	36.96	34.67	33.81	33.24	32.91	32.66	32.49	32.45	32.42	32.40	32.36	32.33	32.31	32.30	32.30
.47	36.66	34.33	33.47	32.89	32.56	32.31	32.13	32.09	32.06	32.04	32.00	31.97	31.95	31.94	31.94
.48	36.35	34.00	33.12	32.55	32.21	31.96	31.78	31.74	31.71	31.69	31.64	31.62	31.61	31.59	31.58
.49	36.05	33.67	32.78	32.20	31.86	31.60	31.42	31.38	31.35	31.33	31.29	31.26	31.24	31.23	31.23
.50	35.75	33.33	32.44	31.85	31.51	31.25	31.07	31.03	31.00	30.98	30.94	30.91	30.89	30.88	30.87
.51	35.44	33.00	32.10	31.51	31.16	30.90	30.72	30.68	30.65	30.63	30.59	30.55	30.55	30.53	30.52
.52	35.13	32.67	31.76	31.16	30.81	30.55	30.37	30.33	30.30	30.28	30.24	30.21	30.19	30.18	30.17
.53	34.82	32.33	31.42	30.82	30.46	30.21	30.02	29.98	29.95	29.93	29.89	29.86	29.84	29.83	29.83
.54	34.51	32.00	31.08	30.47	30.12	29.86	29.68	29.64	29.61	29.59	29.54	29.52	29.50	29.48	29.48
.55	34.20	31.67	30.74	30.13	29.78	29.52	29.33	29.29	29.26	29.24	29.20	29.17	29.15	29.14	29.14
.56	33.88	31.33	30.40	29.79	29.44	29.18	28.99	28.95	28.92	28.90	28.86	28.83	28.81	28.80	28.79
.57	33.57	31.00	30.06	29.45	29.09	28.83	28.65	28.61	28.58	28.56	28.52	28.49	28.47	28.46	28.45
.58	33.25	30.67	29.73	29.11	28.76	28.50	28.31	28.27	28.24	28.22	28.18	28.15	28.13	28.12	28.12
.59	32.93	30.33	29.39	28.77	28.42	28.16	27.97	27.93	27.91	27.89	27.84	27.82	27.80	27.78	27.78
.60	32.61	30.00	29.05	28.44	28.08	27.82	27.64	27.60	27.57	27.55	27.51	27.48	27.46	27.45	27.45
.61	32.28	29.67	28.72	28.10	27.75	27.49	27.31	27.27	27.24	27.22	27.17	27.15	27.14	27.12	27.11
.62	31.96	29.33	28.39	27.77	27.41	27.16	26.97	26.93	26.91	26.89	26.84	26.82	26.81	26.79	26.78
.63	31.63	29.00	28.05	27.44	27.08	26.82	26.64	26.60	26.58	26.56	26.51	26.49	26.48	26.46	26.45
.64	31.30	28.67	27.72	27.11	26.75	26.50	26.32	26.28	26.25	26.23	26.19	26.16	26.14	26.13	26.13
.65	30.97	28.33	27.39	26.78	26.42	26.17	25.99	25.95	25.92	25.90	25.86	25.84	25.83	25.81	25.80
.66	30.63	28.00	27.06	26.45	26.10	25.84	25.67	25.63	25.60	25.58	25.54	25.52	25.50	25.48	25.48
.67	30.30	27.67	26.73	26.12	25.77	25.52	25.34	25.30	25.28	25.26	25.22	25.20	25.18	25.16	25.16
.68	29.96	27.33	26.40	25.79	25.45	25.20	25.02	24.98	24.96	24.94	24.90	24.88	24.87	24.85	24.84
.69	29.61	27.00	26.07	25.47	25.12	24.88	24.71	24.67	24.64	24.62	24.58	24.56	24.55	24.53	24.53

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
.70	29.27	26.67	25.74	25.14	24.80	24.56	24.39	24.35	24.32	24.31	24.27	24.25	24.24	24.22	24.21
.71	28.92	26.33	25.41	24.82	24.48	24.24	24.07	24.03	24.01	23.99	23.95	23.93	23.91	23.90	23.90
.72	28.57	26.00	25.09	24.50	24.17	23.93	23.76	23.72	23.70	23.68	23.64	23.62	23.60	23.59	23.59
.73	28.22	25.67	24.76	24.18	23.85	23.61	23.45	23.41	23.39	23.37	23.33	23.32	23.30	23.29	23.29
.74	27.86	25.33	24.44	23.86	23.54	23.30	23.14	23.10	23.08	23.07	23.03	23.01	23.00	22.98	22.98
.75	27.50	25.00	24.11	23.55	23.22	22.99	22.84	22.80	22.78	22.76	22.72	22.71	22.69	22.68	22.68
.76	27.13	24.67	23.79	23.23	22.91	22.69	22.53	22.49	22.47	22.46	22.42	22.41	22.39	22.38	22.38
.77	26.77	24.33	23.47	22.92	22.60	22.38	22.23	22.19	22.17	22.16	22.12	22.11	22.09	22.08	22.08
.78	26.39	24.00	23.15	22.60	22.30	22.08	21.93	21.90	21.88	21.86	21.83	21.81	21.80	21.78	21.78
.79	26.02	23.67	22.83	22.29	21.99	21.78	21.64	21.60	21.58	21.57	21.53	21.52	21.50	21.49	21.49
.80	25.64	23.33	22.51	21.98	21.69	21.48	21.34	21.30	21.28	21.27	21.24	21.22	21.22	21.20	21.20
.81	25.25	23.00	22.19	21.68	21.39	21.18	21.04	21.01	20.99	20.98	20.95	20.93	20.93	20.91	20.91
.82	24.86	22.67	21.87	21.37	21.09	20.89	20.75	20.72	20.70	20.69	20.66	20.64	20.64	20.62	20.62
.83	24.47	22.33	21.56	21.06	20.79	20.59	20.46	20.43	20.41	20.40	20.37	20.36	20.35	20.34	20.34
.84	24.07	22.00	21.24	20.76	20.49	20.30	20.17	20.15	20.13	20.12	20.09	20.08	20.06	20.06	20.06
.85	23.67	21.67	20.93	20.46	20.20	20.01	19.89	19.87	19.85	19.84	19.81	19.79	19.79	19.78	19.78
.86	23.26	21.33	20.62	20.16	19.90	19.73	19.60	19.58	19.57	19.56	19.54	19.52	19.51	19.50	19.50
.87	22.84	21.00	20.31	19.86	19.61	19.44	19.32	19.31	19.29	19.28	19.25	19.24	19.24	19.22	19.22
.88	22.42	20.67	20.00	19.57	19.33	19.16	19.04	19.03	19.01	19.00	18.98	18.97	18.96	18.95	18.95
.89	21.99	20.33	19.69	19.27	19.04	18.88	18.77	18.75	18.74	18.73	18.70	18.69	18.69	18.68	18.68
.90	21.55	20.00	19.38	18.98	18.75	18.60	18.50	18.48	18.47	18.46	18.43	18.42	18.42	18.41	18.41
.91	21.11	19.67	19.07	18.69	18.47	18.32	18.22	18.21	18.20	18.19	18.17	18.17	18.16	18.15	18.15
.92	20.66	19.33	18.77	18.40	18.19	18.05	17.96	17.95	17.93	17.92	17.90	17.89	17.89	17.88	17.88
.93	20.20	19.00	18.46	18.11	17.91	17.78	17.69	17.68	17.67	17.66	17.65	17.63	17.63	17.62	17.62
.94	19.74	18.67	18.16	17.82	17.64	17.51	17.43	17.42	17.41	17.40	17.39	17.37	17.37	17.36	17.36
.95	19.25	18.33	17.86	17.54	17.36	17.24	17.17	17.16	17.15	17.14	17.13	17.12	17.12	17.11	17.11
.96	18.76	18.00	17.56	17.26	17.09	16.98	16.91	16.90	16.89	16.88	16.87	16.86	16.86	16.86	16.86
.97	18.25	17.67	17.25	16.97	16.82	16.71	16.65	16.64	16.63	16.63	16.62	16.61	16.61	16.60	16.60
.98	17.74	17.33	16.96	16.70	16.55	16.45	16.39	16.38	16.38	16.37	16.37	16.36	16.36	16.36	16.36
.99	17.21	17.00	16.66	16.42	16.28	16.19	16.14	16.13	16.13	16.12	16.12	16.11	16.11	16.11	16.11
1.00	16.67	16.67	16.36	16.14	16.02	15.94	15.89	15.88	15.88	15.88	15.87	15.87	15.87	15.87	15.87
1.01	16.11	16.33	16.07	15.87	15.76	15.68	15.64	15.63	15.63	15.63	15.63	15.62	15.62	15.62	15.62
1.02	15.53	16.00	15.78	15.60	15.50	15.43	15.40	15.39	15.39	15.39	15.39	15.38	15.38	15.38	15.38
1.03	14.93	15.67	15.48	15.33	15.24	15.18	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15	15.15
1.04	14.31	15.33	15.19	15.06	14.98	14.94	14.91	14.91	14.91	14.91	14.91	14.91	14.91	14.91	14.91
1.05	13.66	15.00	14.91	14.79	14.73	14.69	14.67	14.67	14.67	14.67	14.68	14.68	14.68	14.68	14.68
1.06	12.98	14.67	14.62	14.53	14.48	14.45	14.44	14.44	14.44	14.44	14.44	14.45	14.45	14.45	14.45
1.07	12.27	14.33	14.33	14.27	14.23	14.21	14.20	14.21	14.21	14.21	14.21	14.22	14.22	14.22	14.22
1.08	11.51	14.00	14.05	14.01	13.98	13.97	13.97	13.98	13.98	13.98	13.99	13.99	13.99	14.00	14.00
1.09	10.71	13.67	13.76	13.75	13.74	13.73	13.74	13.75	13.75	13.75	13.76	13.77	13.77	13.78	13.78

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
1.10	9.84	13.33	13.48	13.50	13.49	13.50	13.52	13.52	13.52	13.53	13.54	13.55	13.55	13.56	13.56
1.11	8.89	13.00	13.20	13.24	13.25	13.27	13.29	13.30	13.30	13.31	13.32	13.32	13.33	13.34	13.34
1.12	7.82	12.67	12.93	12.99	13.02	13.04	13.07	13.08	13.08	13.09	13.10	13.12	13.12	13.12	13.12
1.13	6.60	12.33	12.65	12.74	12.78	12.81	12.85	12.86	12.86	12.87	12.89	12.89	12.90	12.91	12.91
1.14	5.08	12.00	12.37	12.49	12.55	12.59	12.63	12.64	12.65	12.66	12.67	12.69	12.69	12.70	12.70
1.15	0.29	11.67	12.10	12.25	12.31	12.37	12.42	12.43	12.44	12.45	12.46	12.48	12.48	12.49	12.49
1.16	0.00	11.33	11.83	12.00	12.08	12.15	12.21	12.22	12.23	12.24	12.25	12.27	12.28	12.29	12.29
1.17	0.00	11.00	11.56	11.76	11.86	11.93	12.00	12.01	12.02	12.03	12.06	12.07	12.07	12.08	12.08
1.18	0.00	10.67	11.29	11.52	11.63	11.71	11.79	11.80	11.81	11.82	11.84	11.86	11.88	11.88	11.88
1.19	0.00	10.33	11.02	11.29	11.41	11.50	11.58	11.60	11.61	11.62	11.65	11.66	11.68	11.69	11.69
1.20	0.00	10.00	10.76	11.05	11.19	11.29	11.38	11.40	11.41	11.42	11.45	11.47	11.47	11.49	11.49
1.21	0.00	9.67	10.50	10.82	10.97	11.08	11.18	11.20	11.21	11.22	11.26	11.27	11.29	11.30	11.30
1.22	0.00	9.33	10.23	10.59	10.76	10.88	10.98	11.00	11.02	11.03	11.06	11.08	11.09	11.10	11.10
1.23	0.00	9.00	9.97	10.36	10.54	10.67	10.78	10.80	10.82	10.84	10.87	10.89	10.90	10.91	10.91
1.24	0.00	8.67	9.72	10.13	10.33	10.47	10.58	10.61	10.63	10.64	10.68	10.70	10.71	10.73	10.73
1.25	0.00	8.33	9.46	9.91	10.12	10.27	10.39	10.42	10.44	10.46	10.49	10.51	10.52	10.54	10.54
1.26	0.00	8.00	9.21	9.69	9.92	10.08	10.20	10.24	10.26	10.27	10.31	10.33	10.34	10.36	10.36
1.27	0.00	7.67	8.96	9.47	9.71	9.88	10.01	10.05	10.07	10.09	10.13	10.15	10.17	10.18	10.18
1.28	0.00	7.33	8.71	9.25	9.51	9.69	9.83	9.87	9.89	9.90	9.95	9.97	9.99	10.00	10.00
1.29	0.00	7.00	8.46	9.04	9.31	9.50	9.64	9.68	9.71	9.72	9.77	9.79	9.81	9.83	9.83
1.30	0.00	6.67	8.21	8.83	9.11	9.32	9.47	9.51	9.53	9.55	9.59	9.62	9.64	9.65	9.65
1.31	0.00	6.33	7.97	8.62	8.92	9.13	9.29	9.33	9.35	9.37	9.42	9.45	9.47	9.48	9.48
1.32	0.00	6.00	7.73	8.41	8.73	8.95	9.11	9.15	9.18	9.20	9.25	9.28	9.30	9.31	9.31
1.33	0.00	5.67	7.49	8.20	8.54	8.77	8.94	8.98	9.01	9.03	9.08	9.11	9.13	9.14	9.15
1.34	0.00	5.33	7.25	8.00	8.35	8.59	8.77	8.81	8.84	8.86	8.91	8.94	8.96	8.98	8.98
1.35	0.00	5.00	7.02	7.80	8.16	8.41	8.60	8.64	8.67	8.69	8.75	8.78	8.80	8.82	8.82
1.36	0.00	4.67	6.79	7.60	7.98	8.24	8.43	8.48	8.51	8.53	8.59	8.62	8.64	8.66	8.66
1.37	0.00	4.33	6.56	7.40	7.80	8.07	8.27	8.31	8.34	8.37	8.43	8.46	8.48	8.50	8.50
1.38	0.00	4.00	6.33	7.21	7.62	7.90	8.11	8.15	8.18	8.21	8.26	8.30	8.32	8.34	8.35
1.39	0.00	3.67	6.10	7.02	7.45	7.73	7.95	7.99	8.02	8.05	8.11	8.14	8.17	8.19	8.19
1.40	0.00	3.33	5.88	6.83	7.27	7.57	7.79	7.84	7.88	7.90	7.96	8.00	8.02	8.03	8.04
1.41	0.00	3.00	5.66	6.65	7.10	7.41	7.63	7.68	7.71	7.74	7.81	7.85	7.87	7.88	7.89
1.42	0.00	2.67	5.44	6.46	6.93	7.25	7.48	7.53	7.56	7.59	7.66	7.70	7.72	7.74	7.74
1.43	0.00	2.33	5.23	6.28	6.76	7.09	7.33	7.38	7.41	7.44	7.51	7.54	7.57	7.59	7.60
1.44	0.00	2.00	5.01	6.10	6.60	6.93	7.18	7.24	7.28	7.30	7.37	7.41	7.43	7.45	7.46
1.45	0.00	1.67	4.81	5.93	6.44	6.78	7.03	7.09	7.13	7.15	7.23	7.27	7.29	7.30	7.32
1.46	0.00	1.33	4.60	5.75	6.28	6.63	6.89	6.95	6.99	7.01	7.09	7.13	7.15	7.17	7.18
1.47	0.00	1.00	4.39	5.58	6.12	6.48	6.74	6.80	6.85	6.87	6.95	6.99	7.01	7.03	7.04
1.48	0.00	0.67	4.19	5.41	5.96	6.34	6.60	6.66	6.71	6.73	6.81	6.85	6.87	6.89	6.90
1.49	0.00	0.33	3.99	5.24	5.81	6.19	6.47	6.53	6.57	6.60	6.67	6.72	6.74	6.76	6.77

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
1.50	0.00	0.00	3.80	5.08	5.66	6.05	6.33	6.39	6.43	6.46	6.54	6.58	6.61	6.63	6.64
1.51	0.00	0.00	3.61	4.92	5.51	5.91	6.19	6.25	6.30	6.33	6.41	6.45	6.48	6.50	6.51
1.52	0.00	0.00	3.42	4.76	5.37	5.77	6.06	6.12	6.17	6.20	6.28	6.32	6.35	6.37	6.38
1.53	0.00	0.00	3.23	4.60	5.22	5.64	5.93	5.99	6.04	6.07	6.15	6.20	6.22	6.25	6.26
1.54	0.00	0.00	3.05	4.45	5.08	5.50	5.80	5.86	5.91	5.95	6.03	6.07	6.10	6.12	6.14
1.55	0.00	0.00	2.87	4.30	4.94	5.37	5.68	5.74	5.79	5.82	5.90	5.95	5.98	6.00	6.01
1.56	0.00	0.00	2.69	4.15	4.81	5.24	5.55	5.62	5.67	5.70	5.78	5.83	5.86	5.88	5.89
1.57	0.00	0.00	2.52	4.01	4.67	5.11	5.43	5.50	5.55	5.58	5.66	5.71	5.74	5.77	5.79
1.58	0.00	0.00	2.35	3.86	4.54	4.99	5.31	5.38	5.43	5.46	5.55	5.59	5.62	5.65	5.66
1.59	0.00	0.00	2.19	3.72	4.41	4.86	5.19	5.26	5.31	5.34	5.43	5.48	5.51	5.53	5.55
1.60	0.00	0.00	2.03	3.58	4.28	4.74	5.08	5.14	5.19	5.23	5.32	5.36	5.39	5.42	5.43
1.61	0.00	0.00	1.87	3.45	4.16	4.62	4.96	5.03	5.08	5.12	5.20	5.25	5.28	5.31	5.32
1.62	0.00	0.00	1.72	3.31	4.03	4.51	4.85	4.92	4.97	5.01	5.09	5.14	5.17	5.20	5.22
1.63	0.00	0.00	1.57	3.18	3.91	4.39	4.74	4.81	4.86	4.90	4.99	5.04	5.07	5.10	5.12
1.64	0.00	0.00	1.42	3.06	3.79	4.28	4.63	4.70	4.75	4.79	4.88	4.93	4.96	4.99	5.00
1.65	0.00	0.00	1.28	2.93	3.68	4.17	4.52	4.59	4.64	4.68	4.77	4.83	4.86	4.89	4.91
1.66	0.00	0.00	1.15	2.81	3.56	4.06	4.41	4.49	4.54	4.58	4.67	4.72	4.75	4.79	4.81
1.67	0.00	0.00	1.02	2.69	3.45	3.95	4.31	4.39	4.44	4.48	4.57	4.62	4.65	4.69	4.71
1.68	0.00	0.00	0.89	2.57	3.34	3.85	4.21	4.29	4.34	4.38	4.47	4.53	4.56	4.59	4.61
1.69	0.00	0.00	0.77	2.46	3.23	3.74	4.10	4.19	4.24	4.28	4.37	4.43	4.46	4.49	4.51
1.70	0.00	0.00	0.66	2.35	3.13	3.64	4.00	4.09	4.14	4.18	4.28	4.33	4.36	4.40	4.42
1.71	0.00	0.00	0.55	2.24	3.02	3.54	3.92	3.99	4.05	4.09	4.18	4.24	4.27	4.30	4.31
1.72	0.00	0.00	0.45	2.13	2.92	3.45	3.82	3.90	3.95	3.99	4.09	4.15	4.18	4.21	4.23
1.73	0.00	0.00	0.36	2.03	2.82	3.35	3.73	3.81	3.86	3.90	4.00	4.06	4.09	4.12	4.14
1.74	0.00	0.00	0.27	1.93	2.73	3.26	3.63	3.72	3.77	3.81	3.91	3.97	4.00	4.03	4.05
1.75	0.00	0.00	0.19	1.83	2.63	3.16	3.54	3.63	3.68	3.72	3.82	3.88	3.91	3.94	3.96
1.76	0.00	0.00	0.12	1.73	2.54	3.07	3.45	3.54	3.59	3.63	3.74	3.79	3.82	3.86	3.88
1.77	0.00	0.00	0.06	1.64	2.45	2.99	3.37	3.45	3.51	3.55	3.65	3.71	3.74	3.77	3.79
1.78	0.00	0.00	0.02	1.55	2.36	2.90	3.28	3.37	3.43	3.47	3.57	3.62	3.65	3.69	3.71
1.79	0.00	0.00	0.00	1.46	2.27	2.81	3.20	3.28	3.34	3.38	3.49	3.54	3.57	3.61	3.63
1.80	0.00	0.00	0.00	1.38	2.19	2.73	3.11	3.20	3.26	3.30	3.41	3.46	3.49	3.53	3.55
1.81	0.00	0.00	0.00	1.29	2.10	2.65	3.03	3.12	3.18	3.22	3.33	3.38	3.41	3.45	3.47
1.82	0.00	0.00	0.00	1.21	2.02	2.57	2.96	3.05	3.11	3.15	3.25	3.31	3.34	3.37	3.39
1.83	0.00	0.00	0.00	1.14	1.94	2.49	2.88	2.97	3.03	3.07	3.17	3.23	3.26	3.30	3.32
1.84	0.00	0.00	0.00	1.06	1.87	2.42	2.80	2.89	2.95	2.99	3.10	3.16	3.19	3.22	3.24
1.85	0.00	0.00	0.00	0.99	1.79	2.34	2.73	2.82	2.88	2.92	3.03	3.08	3.11	3.15	3.17
1.86	0.00	0.00	0.00	0.92	1.72	2.27	2.66	2.75	2.81	2.85	2.95	3.01	3.04	3.08	3.10
1.87	0.00	0.00	0.00	0.86	1.65	2.20	2.59	2.68	2.74	2.78	2.88	2.94	2.97	3.01	3.03
1.88	0.00	0.00	0.00	0.79	1.58	2.13	2.52	2.61	2.67	2.71	2.81	2.87	2.90	2.94	2.96
1.89	0.00	0.00	0.00	0.73	1.51	2.06	2.45	2.54	2.60	2.64	2.75	2.81	2.84	2.87	2.89

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
1.90	0.00	0.00	0.00	0.67	1.45	1.99	2.38	2.47	2.53	2.57	2.68	2.74	2.77	2.81	2.83
1.91	0.00	0.00	0.00	0.62	1.38	1.93	2.32	2.41	2.47	2.51	2.61	2.67	2.70	2.74	2.76
1.92	0.00	0.00	0.00	0.56	1.32	1.86	2.25	2.34	2.41	2.45	2.55	2.61	2.64	2.68	2.70
1.93	0.00	0.00	0.00	0.51	1.26	1.80	2.19	2.28	2.34	2.38	2.49	2.55	2.58	2.61	2.63
1.94	0.00	0.00	0.00	0.46	1.20	1.74	2.13	2.22	2.28	2.32	2.43	2.49	2.52	2.55	2.57
1.95	0.00	0.00	0.00	0.42	1.15	1.68	2.07	2.16	2.22	2.26	2.37	2.43	2.46	2.49	2.51
1.96	0.00	0.00	0.00	0.37	1.09	1.62	2.01	2.10	2.16	2.20	2.31	2.37	2.40	2.43	2.45
1.97	0.00	0.00	0.00	0.33	1.04	1.57	1.95	2.04	2.10	2.14	2.25	2.31	2.34	2.38	2.40
1.98	0.00	0.00	0.00	0.30	0.99	1.51	1.90	1.99	2.05	2.09	2.19	2.25	2.28	2.32	2.34
1.99	0.00	0.00	0.00	0.26	0.94	1.46	1.84	1.93	1.99	2.03	2.14	2.20	2.23	2.26	2.28
2.00	0.00	0.00	0.00	0.23	0.89	1.41	1.79	1.88	1.94	1.98	2.08	2.14	2.17	2.21	2.23
2.01	0.00	0.00	0.00	0.20	0.84	1.36	1.74	1.83	1.89	1.93	2.03	2.09	2.12	2.16	2.18
2.02	0.00	0.00	0.00	0.17	0.80	1.31	1.69	1.78	1.83	1.87	1.98	2.04	2.07	2.10	2.12
2.03	0.00	0.00	0.00	0.14	0.75	1.26	1.64	1.73	1.78	1.82	1.93	1.99	2.02	2.05	2.07
2.04	0.00	0.00	0.00	0.12	0.71	1.21	1.59	1.68	1.73	1.77	1.88	1.94	1.97	2.00	2.02
2.05	0.00	0.00	0.00	0.10	0.67	1.17	1.54	1.63	1.69	1.73	1.83	1.89	1.92	1.95	1.97
2.06	0.00	0.00	0.00	0.08	0.63	1.12	1.49	1.58	1.64	1.68	1.78	1.84	1.87	1.91	1.93
2.07	0.00	0.00	0.00	0.06	0.60	1.08	1.45	1.54	1.59	1.63	1.74	1.79	1.82	1.86	1.88
2.08	0.00	0.00	0.00	0.05	0.56	1.04	1.40	1.49	1.55	1.59	1.69	1.75	1.78	1.81	1.83
2.09	0.00	0.00	0.00	0.03	0.53	1.00	1.36	1.45	1.50	1.54	1.64	1.70	1.73	1.77	1.79
2.10	0.00	0.00	0.00	0.02	0.49	0.96	1.32	1.41	1.46	1.50	1.60	1.66	1.69	1.72	1.74
2.11	0.00	0.00	0.00	0.01	0.46	0.92	1.28	1.36	1.42	1.46	1.56	1.61	1.64	1.68	1.70
2.12	0.00	0.00	0.00	0.00	0.43	0.88	1.24	1.32	1.38	1.42	1.52	1.57	1.60	1.64	1.66
2.13	0.00	0.00	0.00	0.00	0.40	0.85	1.20	1.28	1.34	1.38	1.48	1.53	1.56	1.60	1.62
2.14	0.00	0.00	0.00	0.00	0.38	0.81	1.16	1.25	1.30	1.34	1.44	1.49	1.52	1.56	1.58
2.15	0.00	0.00	0.00	0.00	0.35	0.78	1.13	1.21	1.26	1.30	1.40	1.45	1.48	1.52	1.54
2.16	0.00	0.00	0.00	0.00	0.32	0.75	1.09	1.17	1.22	1.26	1.36	1.41	1.44	1.48	1.50
2.17	0.00	0.00	0.00	0.00	0.30	0.71	1.06	1.13	1.18	1.22	1.32	1.38	1.41	1.44	1.46
2.18	0.00	0.00	0.00	0.00	0.28	0.68	1.02	1.10	1.15	1.19	1.28	1.34	1.37	1.40	1.41
2.19	0.00	0.00	0.00	0.00	0.26	0.65	0.99	1.06	1.11	1.15	1.25	1.30	1.33	1.37	1.39
2.20	0.000	0.000	0.000	0.000	0.236	0.625	0.954	1.030	1.083	1.122	1.214	1.267	1.299	1.330	1.346
2.21	0.000	0.000	0.000	0.000	0.217	0.597	0.922	0.997	1.058	1.089	1.180	1.233	1.265	1.295	1.311
2.22	0.000	0.000	0.000	0.000	0.199	0.570	0.891	0.966	1.018	1.056	1.147	1.199	1.231	1.261	1.277
2.23	0.000	0.000	0.000	0.000	0.182	0.544	0.861	0.935	0.986	1.025	1.115	1.167	1.197	1.228	1.244
2.24	0.000	0.000	0.000	0.000	0.166	0.519	0.831	0.905	0.956	0.994	1.083	1.135	1.165	1.195	1.211
2.25	0.000	0.000	0.000	0.000	0.150	0.495	0.802	0.875	0.926	0.964	1.052	1.104	1.134	1.163	1.179
2.26	0.000	0.000	0.000	0.000	0.136	0.471	0.775	0.847	0.897	0.935	1.022	1.073	1.103	1.132	1.148
2.27	0.000	0.000	0.000	0.000	0.123	0.449	0.748	0.819	0.869	0.906	0.993	1.043	1.073	1.103	1.118
2.28	0.000	0.000	0.000	0.000	0.111	0.427	0.722	0.792	0.841	0.878	0.964	1.014	1.044	1.073	1.088
2.29	0.000	0.000	0.000	0.000	0.099	0.406	0.697	0.766	0.814	0.851	0.936	0.986	1.015	1.044	1.059

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
2.30	0.000	0.000	0.000	0.000	0.089	0.386	0.672	0.741	0.789	0.825	0.909	0.959	0.988	1.016	1.031
2.31	0.000	0.000	0.000	0.000	0.079	0.367	0.648	0.716	0.763	0.799	0.882	0.931	0.960	0.988	1.003
2.32	0.000	0.000	0.000	0.000	0.070	0.348	0.624	0.691	0.739	0.774	0.856	0.905	0.934	0.962	0.976
2.33	0.000	0.000	0.000	0.000	0.061	0.330	0.601	0.668	0.715	0.750	0.831	0.879	0.908	0.935	0.950
2.34	0.000	0.000	0.000	0.000	0.054	0.313	0.579	0.645	0.691	0.720	0.807	0.854	0.882	0.909	0.924
2.35	0.000	0.000	0.000	0.000	0.047	0.296	0.558	0.623	0.669	0.703	0.782	0.829	0.857	0.884	0.889
2.36	0.000	0.000	0.000	0.000	0.040	0.280	0.538	0.602	0.646	0.680	0.759	0.806	0.833	0.860	0.874
2.37	0.000	0.000	0.000	0.000	0.035	0.265	0.518	0.580	0.624	0.658	0.736	0.782	0.809	0.836	0.850
2.38	0.000	0.000	0.000	0.000	0.029	0.250	0.498	0.560	0.604	0.637	0.714	0.759	0.787	0.813	0.827
2.39	0.000	0.000	0.000	0.000	0.025	0.236	0.479	0.541	0.584	0.616	0.693	0.737	0.764	0.791	0.804
2.40	0.000	0.000	0.000	0.000	0.021	0.223	0.461	0.521	0.564	0.596	0.671	0.715	0.742	0.769	0.782
2.41	0.000	0.000	0.000	0.000	0.017	0.210	0.443	0.503	0.545	0.577	0.651	0.695	0.721	0.747	0.760
2.42	0.000	0.000	0.000	0.000	0.014	0.198	0.426	0.485	0.526	0.557	0.631	0.674	0.701	0.726	0.739
2.43	0.000	0.000	0.000	0.000	0.011	0.186	0.410	0.467	0.508	0.539	0.611	0.654	0.679	0.705	0.718
2.44	0.000	0.000	0.000	0.000	0.009	0.175	0.393	0.450	0.491	0.521	0.593	0.635	0.660	0.685	0.698
2.45	0.000	0.000	0.000	0.000	0.007	0.165	0.378	0.434	0.473	0.503	0.573	0.616	0.641	0.665	0.678
2.46	0.000	0.000	0.000	0.000	0.005	0.154	0.362	0.417	0.456	0.486	0.556	0.597	0.622	0.646	0.659
2.47	0.000	0.000	0.000	0.000	0.004	0.145	0.348	0.403	0.441	0.470	0.538	0.579	0.604	0.627	0.640
2.48	0.000	0.000	0.000	0.000	0.003	0.136	0.333	0.387	0.425	0.454	0.522	0.562	0.586	0.609	0.622
2.49	0.000	0.000	0.000	0.000	0.002	0.127	0.321	0.372	0.409	0.438	0.504	0.545	0.569	0.593	0.605
2.50	0.000	0.000	0.000	0.000	0.001	0.118	0.307	0.358	0.395	0.423	0.489	0.528	0.552	0.575	0.587
2.51	0.000	0.000	0.000	0.000	0.001	0.111	0.294	0.345	0.381	0.409	0.473	0.512	0.536	0.558	0.570
2.52	0.000	0.000	0.000	0.000	0.000	0.103	0.282	0.331	0.367	0.394	0.458	0.497	0.519	0.542	0.553
2.53	0.000	0.000	0.000	0.000	0.000	0.096	0.270	0.319	0.354	0.381	0.444	0.481	0.503	0.526	0.537
2.54	0.000	0.000	0.000	0.000	0.000	0.089	0.258	0.306	0.340	0.367	0.428	0.466	0.488	0.510	0.522
2.55	0.000	0.000	0.000	0.000	0.000	0.083	0.247	0.294	0.328	0.354	0.415	0.451	0.473	0.495	0.506
2.56	0.000	0.000	0.000	0.000	0.000	0.077	0.237	0.283	0.316	0.341	0.401	0.437	0.459	0.480	0.491
2.57	0.000	0.000	0.000	0.000	0.000	0.071	0.227	0.272	0.304	0.328	0.388	0.424	0.445	0.466	0.477
2.58	0.000	0.000	0.000	0.000	0.000	0.066	0.217	0.261	0.292	0.317	0.376	0.411	0.432	0.452	0.463
2.59	0.000	0.000	0.000	0.000	0.000	0.061	0.207	0.251	0.282	0.305	0.363	0.397	0.418	0.439	0.449
2.60	0.000	0.000	0.000	0.000	0.000	0.056	0.198	0.240	0.271	0.294	0.351	0.385	0.406	0.426	0.436
2.61	0.000	0.000	0.000	0.000	0.000	0.052	0.189	0.231	0.260	0.283	0.339	0.372	0.393	0.413	0.423
2.62	0.000	0.000	0.000	0.000	0.000	0.048	0.181	0.221	0.250	0.273	0.327	0.360	0.381	0.400	0.410
2.63	0.000	0.000	0.000	0.000	0.000	0.044	0.173	0.212	0.241	0.263	0.316	0.349	0.368	0.388	0.398
2.64	0.000	0.000	0.000	0.000	0.000	0.040	0.164	0.203	0.232	0.253	0.306	0.338	0.357	0.376	0.386
2.65	0.000	0.000	0.000	0.000	0.000	0.037	0.157	0.195	0.223	0.244	0.295	0.327	0.346	0.365	0.375
2.66	0.000	0.000	0.000	0.000	0.000	0.034	0.149	0.186	0.213	0.234	0.285	0.316	0.335	0.353	0.363
2.67	0.000	0.000	0.000	0.000	0.000	0.031	0.143	0.179	0.205	0.225	0.275	0.305	0.324	0.342	0.352
2.68	0.000	0.000	0.000	0.000	0.000	0.028	0.136	0.171	0.197	0.217	0.266	0.296	0.314	0.332	0.342
2.69	0.000	0.000	0.000	0.000	0.000	0.025	0.129	0.164	0.190	0.209	0.257	0.286	0.304	0.321	0.331

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
2.70	0.000	0.000	0.000	0.000	0.000	0.023	0.123	0.156	0.182	0.201	0.248	0.277	0.295	0.311	0.321
2.71	0.000	0.000	0.000	0.000	0.000	0.021	0.117	0.150	0.174	0.193	0.239	0.267	0.285	0.302	0.311
2.72	0.000	0.000	0.000	0.000	0.000	0.019	0.111	0.143	0.167	0.185	0.231	0.259	0.275	0.292	0.301
2.73	0.000	0.000	0.000	0.000	0.000	0.017	0.106	0.137	0.160	0.178	0.222	0.250	0.266	0.283	0.292
2.74	0.000	0.000	0.000	0.000	0.000	0.015	0.101	0.131	0.153	0.171	0.215	0.241	0.258	0.274	0.282
2.75	0.000	0.000	0.000	0.000	0.000	0.014	0.096	0.125	0.147	0.164	0.207	0.233	0.248	0.266	0.274
2.76	0.000	0.000	0.000	0.000	0.000	0.012	0.091	0.120	0.141	0.158	0.200	0.225	0.241	0.257	0.265
2.77	0.000	0.000	0.000	0.000	0.000	0.011	0.086	0.114	0.135	0.152	0.192	0.217	0.232	0.249	0.257
2.78	0.000	0.000	0.000	0.000	0.000	0.010	0.081	0.109	0.130	0.146	0.185	0.210	0.226	0.241	0.249
2.79	0.000	0.000	0.000	0.000	0.000	0.008	0.077	0.103	0.124	0.140	0.179	0.202	0.218	0.233	0.241
2.80	0.000	0.000	0.000	0.000	0.000	0.007	0.074	0.099	0.118	0.134	0.172	0.196	0.210	0.225	0.233
2.81	0.000	0.000	0.000	0.000	0.000	0.007	0.070	0.094	0.113	0.129	0.165	0.189	0.204	0.218	0.226
2.82	0.000	0.000	0.000	0.000	0.000	0.006	0.066	0.090	0.109	0.123	0.159	0.183	0.194	0.211	0.219
2.83	0.000	0.000	0.000	0.000	0.000	0.005	0.062	0.085	0.103	0.118	0.154	0.176	0.190	0.204	0.212
2.84	0.000	0.000	0.000	0.000	0.000	0.004	0.059	0.082	0.099	0.113	0.148	0.170	0.184	0.197	0.205
2.85	0.000	0.000	0.000	0.000	0.000	0.004	0.055	0.078	0.095	0.109	0.143	0.164	0.178	0.191	0.198
2.86	0.000	0.000	0.000	0.000	0.000	0.003	0.053	0.074	0.091	0.104	0.137	0.159	0.172	0.185	0.192
2.87	0.000	0.000	0.000	0.000	0.000	0.003	0.050	0.070	0.087	0.100	0.132	0.152	0.166	0.179	0.185
2.88	0.000	0.000	0.000	0.000	0.000	0.002	0.047	0.067	0.082	0.095	0.127	0.147	0.160	0.173	0.179
2.89	0.000	0.000	0.000	0.000	0.000	0.002	0.044	0.064	0.079	0.091	0.122	0.142	0.155	0.167	0.173
2.90	0.000	0.000	0.000	0.000	0.000	0.002	0.042	0.061	0.075	0.088	0.117	0.138	0.149	0.161	0.168
2.91	0.000	0.000	0.000	0.000	0.000	0.001	0.039	0.057	0.072	0.084	0.112	0.132	0.145	0.156	0.162
2.92	0.000	0.000	0.000	0.000	0.000	0.001	0.037	0.055	0.069	0.080	0.107	0.127	0.140	0.151	0.157
2.93	0.000	0.000	0.000	0.000	0.000	0.001	0.035	0.052	0.066	0.077	0.104	0.123	0.134	0.146	0.151
2.94	0.000	0.000	0.000	0.000	0.000	0.001	0.033	0.049	0.062	0.073	0.100	0.118	0.129	0.141	0.146
2.95	0.000	0.000	0.000	0.000	0.000	0.001	0.031	0.047	0.059	0.070	0.096	0.114	0.125	0.136	0.142
2.96	0.000	0.000	0.000	0.000	0.000	0.001	0.029	0.044	0.056	0.067	0.092	0.110	0.121	0.132	0.137
2.97	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.042	0.054	0.064	0.088	0.105	0.116	0.127	0.132
2.98	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.039	0.051	0.061	0.085	0.101	0.112	0.123	0.128
2.99	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.038	0.049	0.058	0.082	0.098	0.108	0.119	0.124
3.00	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.036	0.047	0.056	0.078	0.094	0.105	0.115	0.120
3.01	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.034	0.044	0.053	0.075	0.091	0.101	0.111	0.116
3.02	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.032	0.042	0.050	0.072	0.087	0.097	0.107	0.112
3.03	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.030	0.040	0.048	0.069	0.084	0.094	0.103	0.108
3.04	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.028	0.038	0.045	0.066	0.081	0.090	0.099	0.104
3.05	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.027	0.036	0.043	0.064	0.078	0.086	0.096	0.101
3.06	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.025	0.034	0.041	0.061	0.075	0.083	0.092	0.097
3.07	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.024	0.032	0.039	0.059	0.072	0.080	0.089	0.094
3.08	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.022	0.030	0.037	0.056	0.069	0.077	0.086	0.091
3.09	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.021	0.029	0.036	0.054	0.067	0.075	0.083	0.088

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
3.10	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.020	0.027	0.034	0.051	0.064	0.072	0.080	0.085
3.11	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.019	0.026	0.032	0.050	0.061	0.069	0.077	0.082
3.12	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.018	0.025	0.031	0.048	0.060	0.067	0.074	0.079
3.13	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.017	0.024	0.029	0.046	0.057	0.064	0.072	0.075
3.14	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.015	0.022	0.028	0.044	0.055	0.062	0.069	0.073
3.15	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.014	0.021	0.026	0.042	0.053	0.060	0.067	0.070
3.16	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.014	0.020	0.025	0.040	0.051	0.057	0.064	0.067
3.17	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.013	0.019	0.024	0.038	0.049	0.056	0.062	0.065
3.18	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.012	0.017	0.022	0.036	0.046	0.053	0.060	0.063
3.19	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.012	0.017	0.021	0.034	0.044	0.052	0.057	0.060
3.20	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.011	0.016	0.020	0.033	0.043	0.049	0.055	0.058
3.21	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.010	0.015	0.019	0.032	0.041	0.047	0.053	0.056
3.22	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.014	0.018	0.031	0.040	0.045	0.051	0.054
3.23	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.013	0.017	0.029	0.037	0.043	0.049	0.052
3.24	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.013	0.016	0.028	0.037	0.042	0.047	0.050
3.25	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.008	0.012	0.015	0.027	0.035	0.040	0.046	0.049
3.26	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.007	0.011	0.015	0.025	0.033	0.039	0.044	0.047
3.27	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.007	0.011	0.014	0.024	0.032	0.037	0.042	0.045
3.28	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.006	0.010	0.013	0.023	0.031	0.036	0.040	0.043
3.29	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.006	0.009	0.012	0.023	0.029	0.034	0.039	0.042
3.30	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.005	0.009	0.012	0.021	0.028	0.033	0.037	0.040
3.31	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.005	0.008	0.011	0.021	0.027	0.032	0.036	0.039
3.32	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.007	0.010	0.020	0.026	0.030	0.034	0.037
3.33	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.007	0.010	0.019	0.025	0.029	0.033	0.036
3.34	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.007	0.009	0.018	0.024	0.028	0.032	0.035
3.35	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.006	0.009	0.017	0.023	0.027	0.031	0.033
3.36	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.006	0.008	0.016	0.022	0.026	0.030	0.032
3.37	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.004	0.006	0.008	0.015	0.021	0.024	0.028	0.031
3.38	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.014	0.019	0.024	0.027	0.030
3.39	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.014	0.019	0.022	0.027	0.029
3.40	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.013	0.018	0.021	0.026	0.028
3.41	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.012	0.018	0.021	0.025	0.027
3.42	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.012	0.017	0.020	0.024	0.026
3.43	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.011	0.016	0.019	0.023	0.025
3.44	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.011	0.015	0.018	0.022	0.024
3.45	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.011	0.014	0.017	0.021	0.023
3.46	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.010	0.014	0.017	0.020	0.022
3.47	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.010	0.014	0.016	0.019	0.021
3.48	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.009	0.013	0.015	0.018	0.020
3.49	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.004	0.009	0.012	0.015	0.018	0.020

[1]Values tabulated are read in percent.

Table C-5—Continued

Table for Estimating the Lot Percent Nonconforming Using Range Method[1]

Q_U or Q_L	Sample Size														
	3	4	5	7	10	15	25	30	35	40	60	85	115	175	230
3.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.008	0.012	0.014	0.017	0.019
3.51	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.008	0.011	0.014	0.016	0.018
3.52	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.007	0.010	0.013	0.016	0.017
3.53	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.007	0.010	0.013	0.015	0.016
3.54	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.007	0.010	0.012	0.014	0.015
3.55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.006	0.009	0.012	0.014	0.015
3.56	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.006	0.009	0.011	0.013	0.014
3.57	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.008	0.011	0.012	0.013
3.58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.008	0.010	0.012	0.013
3.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.008	0.010	0.011	0.012
3.60	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.005	0.007	0.009	0.011	0.012
3.61	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.007	0.009	0.011	0.011
3.62	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.007	0.009	0.010	0.011
3.63	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.004	0.006	0.008	0.010	0.010
3.64	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.003	0.006	0.008	0.009	0.010
3.65	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.003	0.006	0.008	0.009	0.010
3.66	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.009	0.009
3.67	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.007	0.008	0.009
3.68	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.005	0.006	0.008	0.008
3.69	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.008	0.008
3.70	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.008
3.71	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.007
3.72	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.007
3.73	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.006	0.007	0.007
3.74	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.005	0.006	0.007
3.75	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.006	0.006
3.76	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.006	0.006
3.77	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.005	0.006	0.006
3.78	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.004	0.005	0.005
3.79	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.003	0.005	0.005
3.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.003	0.005	0.005
3.81	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.003	0.005	0.005
3.82	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.003	0.005	0.005
3.83	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.003	0.004	0.004
3.84	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.004	0.004
3.85	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.004
3.86	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.004
3.87	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.004
3.88	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.004	0.004
3.89	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.003
3.90	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.003

[1]Values tabulated are read in percent.

Table C-6
Values of f for Maximum Average Range (MAR)

Sample size	Acceptable Quality Levels (in percent nonconforming)											
	T	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
3									.833	.865	.907	.958
4							.756	.788	.836	.891	.965	1.056
5						.730	.764	.801	.857	.923	1.011	1.118
7				.695	.727	.765	.804	.846	.910	.985	1.086	1.209
10			.529	.553	.579	.610	.642	.677	.730	.793	.876	.977
15	.460	.477	.493	.517	.542	.572	.602	.637	.688	.748	.830	.928
25	.432	.447	.463	.486	.509	.537	.567	.600	.649	.707	.785	.879
30	.426	.442	.457	.480	.503	.531	.560	.593	.642	.699	.776	.870
35	.423	.438	.454	.476	.499	.527	.556	.588	.637	.694	.771	.864
40	.417	.432	.447	.469	.492	.519	.548	.580	.628	.684	.761	.852
50	.411	.426	.441	.463	.486	.503	.542	.573	.621	.676	.752	.843
60	.405	.419	.434	.455	.478	.505	.533	.564	.608	.666	.740	.830
85	.398	.412	.427	.448	.470	.497	.525	.555	.602	.656	.729	.818
115	.392	.406	.421	.442	.464	.490	.517	.548	.594	.648	.720	.808
175	.384	.399	.413	.434	.455	.481	.508	.538	.584	.637	.708	.794
230	.384	.397	.412	.432	.454	.480	.507	.536	.582	.633	.706	.792

The MAR may be obtained by multiplying the factor f by the difference between the upper specification limit U and lower specification limit L. The formula is MAR = f(U – L). The MAR serves as a guide for the magnitude of the average range of the sample when using plans for the double specification limit case, based on the average range of the sample of unknown variability. The average range of the sample, if it is less than the MAR, helps to insure, but does not guarantee, lot acceptability.

NOTE: There is a corresponding acceptability constant in Table C-1 for each value of f. For reduced inspection, find the acceptability constant of Table C-2 in Table C-1 and use the corresponding value of f.

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

APPENDIX C
Definitions

Symbol	Read	Definitions
n		Sample size for a single lot.
$\bar{X}$	X bar	Sample mean. Arithmetic mean of sample measurements from a single lot.
R		Range. The difference between the largest and smallest measurements in a subgroup. In this Standard, the subgroup size is 5 except for those plans in which n = 3, 4, or 7, in which case the subgroup is the same as the sample size.
R_1		Range of the first subgroup.
R_2		Range of the second subgroup.
$\bar{R}$	R bar	Average range. The arithmetic mean of the range values of the subgroups of the sample measurements from a single lot.
U		Upper specification limit.
L		Lower specification limit.
k		The acceptability constant given in Tables C-1 and C-2.
c		A factor used in determining the quality index when using the range method. The c values are given in Tables C-3 and C-4.
Q_U	Q sub U	Quality Index for use with Table C-5.
Q_L	Q sub L	Quality index for use with Table C-5.
p_U	p sub U	Sample estimate of the lot percent nonconforming above U from Table C-5.
p_L	p sub L	Sample estimate of the lot percent nonconforming below L from Table C-5.
p		Total sample estimate of the lot percent nonconforming $p = p_U + p_L$.
M		Maximum allowable percent nonconforming for sample estimates given in Tables C-3 and C-4.
M_U	M sub U	Maximum allowable percent nonconforming above U given in Tables C-3 and C-4. (For use when different AQL values for U and L are specified.)
M_L	M sub L	Maximum allowable percent nonconforming below L given in Tables C-3 and C-4. (For use when different AQL values for U and L are specified.)
$\bar{p}$	p bar	Sample estimate of the process percent nonconforming, i.e., the estimated process average.
$\bar{p}_U$	p bar sub U	The estimated process average for an upper specification limit.
$\bar{p}_L$	p bar sub L	The estimated process average for a lower specification limit.
f		A factor used in determining the Maximum Average Range (MAR). The f values are given in Table C-6.
>	Greater than	Greater than.
<	Less than	Less than.
Σ	Sum of	Sum of.
T		AQL symbol denoting plan used exclusively on tightened inspection (provides identification of appropriate OC curve).

SECTION D
VARIABILITY KNOWN
Part I
SINGLE SPECIFICATION LIMIT

D1. SAMPLING PLAN FOR SINGLE SPECIFICATION LIMIT

This part of the Standard describes the procedures for use with plans for a single specification limit when variability of the lot with respect to the quality characteristic is known. The acceptability criterion is given in two equivalent forms. These are identified as Form 1 and Form 2.

D1.1 Use of Sampling Plans. To determine whether the lot meets the acceptability criterion with respect to a particular quality characteristic and AQL value, the applicable sampling plan shall be used in accordance with the provisions of Section A, General Description of Sampling Plans, and those in this part of the Standard.

D1.2 Drawing of Samples. All samples shall be drawn in accordance with paragraph A7.2.

D1.3 Determination of Sample Size Code Letter. The sample size code letter shall be selected from Table A-2 in accordance with paragraph A7.1.

D2. SELECTING THE SAMPLING PLAN WHEN FORM 1 IS USED

D2.1 Master Sampling Tables. The master sampling tables for plans based on variability known for a single specification limit are TAbles D-1 and D-2. Table D-1 is used for normal and tightened inspection and Table D-2 for reduced inspection.

D2.2 Obtaining Sampling Plan. The sampling plan consists of a sample size and an associated acceptability constant.[1] The sampling plan is obtained from Master Table D-1 and D-2.

D2.2.1 Sample Size. The sample size n is shown in the master table corresponding to each sample size code letter and AQL.

D2.2.2 Acceptability Constant. The acceptability constant k, corresponding to the sample size mentioned in paragraph D2.2.1, is indicated in the column of the master table corresponding to the applicable AQL value. Table D-1 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table D-2.

D3. LOT-BY-LOT ACCEPTABILITY PROCEDURES WHEN FORM 1 IS USED[2]

D3.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a single specification limit shall be judged by the quantity $(U-\bar{X})/\sigma$ or $(\bar{X}-L)/\sigma$.

D3.2 Computation. The following quantity shall be computed: $(U-\bar{X})/\sigma$ or $(\bar{X}-L)/\sigma$, depending on whether the specification limit is an upper or a lower limit, where

U is the upper specification limit,
L is the lower specification limit,
$\bar{X}$ is the sample mean, and
σ is the known variability.

D3.3 Acceptability Criteria. Compare the quantity $(U-\bar{X})/\sigma$ or $(\bar{X}-L)/\sigma$ with the acceptability constant k. If $(U-\bar{X})/\sigma$ or $(\bar{X}-L)/\sigma$ is equal to or greater than k, the lot meets the acceptability criterion; if $(U-\bar{X})/\sigma$ or $(\bar{X}-L)/\sigma$ is less than k or negative, then the lot does not meet the acceptability criterion.

D4. SUMMARY FOR OPERATION OF SAMPLING PLAN WHEN FORM 1 IS USED

The following steps summarize the procedures to be followed:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Obtain plan from Master Table D-1 or D-2 by selecting the sample size n and the acceptability constant k.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic for each unit of the sample.

(4) Compute the sample mean $\bar{X}$, and also compute the quantity $(U-\bar{X})/\sigma$ for an upper specification limit U or the quantity $(\bar{X}-L)/\sigma$ for a lower specification limit L.

(5) If the quantity $(U-\bar{X})/\sigma$ or $(\bar{X}-L)/\sigma$ is equal to or greater than k, the lot meets the acceptability criterion; if

[1]See Appendix D for definitions of all symbols used in the sampling plans based on variability known.

[2]See Example D-1 for a complete example of this procedure.

$(U - \bar{X})/\sigma$ or $(\bar{X} - L)/\sigma$ is less than k or negative, then the lot does not meet the acceptability criterion.

D5. SELECTING THE SAMPLING PLAN WHEN FORM 2 IS USED

D5.1 Master Sampling Tables. The master sampling tables for plans based on variability known for a single specification limit are Tables D-3 and D-4 of Part II. Table D-3 is used for normal and tightened inspection and Table D-4 for reduced inspection.

D5.2 Obtaining the Sampling Plan. The sampling plan consists of a sample size and an associated maximum allowable percent nonconforming. The sampling plan is obtained from Master Table D-3 or D-4.

D5.2.1 Sample Size. The sample size n is shown in the master table corresponding to each sample size code letter.

D5.2.2 Maximum Allowable Percent Nonconforming. The maximum allowable percent nonconforming M for sample estimates corresponding to the sample size mentioned in paragraph D5.2.1 is indicated in the column of the master table corresponding to the applicable AQL value. Table D-3 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table D-4.

D6. LOT-BY-LOT ACCEPTABILITY PROCEDURES WHEN FORM 2 IS USED[3]

D6.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a single specification limit shall be judged by the percent of nonconforming product outside the upper or lower specification limit. The percentage of nonconforming product is estimated by entering Table D-5 with the quality index.

D6.2 Computation of Quality Index. The quality index $Q_U = (U - \bar{X})v/\sigma$ shall be computed if the specification limit is an upper limit U, or $Q_U = (\bar{X} - L)v/\sigma$ if it is a lower limit L. The quantities, $\bar{X}$ and σ, are the sample mean and known variability, respectively. The factor v is provided in Tables D-3 and D-4 corresponding to the sample size.

D6.3 Estimate of Percent Nonconforming in Lot. The quality of a lot shall be expressed by p_U, the estimated percent nonconforming in the lot above the upper specification limit, or by p_L, the estimated percent nonconforming below the lower specification limit. The estimated percent nonconforming p_U or p_L is obtained by entering Table D-5 with Q_U or Q_L.

D6.4 Acceptability Criterion. Compare the estimated lot percent nonconforming p_U or p_L with the maximum allowable percent nonconforming M. If p_U or p_L is equal to or less than M, the lot meets the acceptability criterion; if p_U or p_L is greater than M or if Q_U or Q_L is negative, then the lot does not meet the acceptability criterion.

D7. SUMMARY FOR OPERATION OF SAMPLING PLAN WHEN FORM 2 IS USED

The following steps summarize the procedures to be followed:

(1) Determine the sample size code letter from Table A-2 by using the lot size and inspection level.

(2) Obtain plan from Master Table D-3 or D-4 by selecting the sample size n, the factor v, and the maximum allowable percent nonconforming M.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit of the sample.

(4) Compute the sample mean $\bar{X}$.

(5) Compute the quality index $Q_U = (U - \bar{X})v/\sigma$ if an upper specification limit U is specified, or $Q_L = (\bar{X} - L)v/\sigma$ if a lower specification limit L is specified.

(6) Determine the estimated lot percent nonconforming p_U or p_L from Table D-5.

(7) If the estimated lot percent nonconforming p_U or p_L is equal to or less than the maximum allowable percent nonconforming M, the lot meets the acceptability criterion; if p_U or p_L is greater than M or if Q_U or Q_L is negative, then the lot does not meet the acceptability criterion.

[3]See Example D-2 for a complete example of this procedure.

EXAMPLE D-1
Example of Calculations
Single Specification Limit—Form 1
Variability Known

Example: The specified minimum yield point for certain steel castings is 58,000 psi. A lot of 500 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1.5% is to be used. The variability σ is known to be 3000 psi. From Tables A-2 and D-1 it is seen that a sample of size 10 is required. Suppose the yield points of the sample specimens are:

62,500; 60,500; 68,000; 59,000; 65,500
62,000; 61,000; 69,000; 58,000; 64,500;

and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	10	
2	Known Variability: σ	3,000	
3	Sum of Measurements: ΣX	630,000	
4	Sample Mean $\bar{X}$: $\Sigma X/n$	63,000	630,000/10
5	Specification Limit (Lower): L	58,000	
6	The Quantity: $(\bar{X} - L)/\sigma$	1.67	(63,000 – 58,000)/3000
7	Acceptability Constant: k	1.70	See Table D-1
8	Acceptability Criterion: Compare $(\bar{X} - L)/\sigma$ with k	1.67 < 1.70	See Para. D3.3

The lot does not meet the acceptability criterion, since $(\bar{X} - L)/\sigma$ is less than k.

NOTE: If a single upper specification limit U is given, then compute the quantity $(U - \bar{X})/\sigma$ in line 6 and compare it with k; the lot meets the acceptability criterion if $(U - \bar{X})/\sigma$ is equal to or greater than k.

EXAMPLE D-2

Example of Calculations

Single Specification Limit—Form 2

Variability Known

Example: The specified minimum yield point for certain steel castings is 58,000 psi. A lot of 500 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1.5% is to be used. The variability σ is known to be 3000 psi. From Tables A-2 and D-1 it is seen that a sample of size 10 is required. Suppose the yield points of the sample specimens are:

62,500; 60,500; 68,000; 59,000; 65,500;
62,000; 61,000; 69,000; 58,000; 64,500;

and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	10	
2	Known Variability: σ	3,000	
3	Sum of Measurements: ΣX	630,000	
4	Sample Mean $\bar{X}$: $\Sigma X/n$	63,000	630,000/10
5	Factor: v	1.054	
6	Specification Limit (Lower): L	58,000	
7	Quality Index: $Q_L = (\bar{X} - L)v/\sigma$	1.76	$\frac{(63{,}000 - 58{,}000)1.054}{3{,}000}$
8	Est. of Lot Percent: Ncf.: p_L	3.92%	See Table D-5
9	Max. Allowable Percent Ncf.: M	3.63%	See Table D-3
10	Acceptability Criterion: Compare p_L with M	3.92% > 3.63%	See Para. D6.4

The lot does not meet the acceptability criterion, since p_L is greater than M.

NOTE: If a single upper specification limit U is given, then compute the quality index $Q_U = (U - \bar{X})v/\sigma$ in line 7 and obtain the estimate of the percent nonconforming p_U. Compare p_U with M; the lot meets the acceptability criterion if p_U is equal to or less than M.

Table D-1

Master Table for Normal and Tightened Inspection for Plans Based on Variability Known
(Single Specification Limit—Form 1)

Sample size code letter	Acceptable Quality Levels (normal inspection)											
	T		.10		.15		.25		.40		.65	
	n	k	n	k	n	k	n	k	n	k	n	k
B	↓		↓		↓		↓		↓		↓	
C	↓		↓		↓		↓		↓		↓	
D	↓		↓		↓		↓		↓		2	1.58
E	↓		↓		↓		2	1.94	2	1.81	3	1.69
F	↓		↓		3	2.19	3	2.07	3	1.91	4	1.80
G	3	2.49	4	2.39	4	2.30	4	2.14	5	2.05	5	1.88
H	4	2.55	5	2.46	5	2.34	6	2.23	6	2.08	7	1.95
I	6	2.59	6	2.49	6	2.37	7	2.25	8	2.13	8	1.96
J	7	2.63	8	2.54	9	2.45	9	2.29	10	2.16	11	2.01
K	11	2.72	11	2.59	12	2.49	13	2.35	14	2.21	16	2.07
L	15	2.77	16	2.65	17	2.54	19	2.41	21	2.27	23	2.12
M	20	2.80	22	2.69	23	2.57	25	2.43	27	2.29	30	2.14
N	30	2.84	31	2.72	34	2.62	37	2.47	40	2.33	44	2.17
P	40	2.85	42	2.73	45	2.62	49	2.48	54	2.34	59	2.18
	.10		.15		.25		.40		.65		1.00	
	Acceptable Quality Levels (tightened inspection)											

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-1—Continued

Master Table for Normal and Tightened Inspection for Plans Based on Variability Known
(Single Specification Limit—Form 1)

Sample size code letter	Acceptable Quality Levels (normal inspection)											
	1.00		1.50		2.50		4.00		6.50		10.00	
	n	k	n	k	n	k	n	k	n	k	n	k
B	↓		↓		↓		↓		↓		↓	
C	2	1.36	2	1.25	2	1.09	2	.936	3	.755	3	.573
D	2	1.42	2	1.33	3	1.17	3	1.01	3	.825	4	.641
E	3	1.56	3	1.44	4	1.28	4	1.11	5	.919	5	.728
F	4	1.69	4	1.53	5	1.39	5	1.20	6	.991	7	.797
G	6	1.78	6	1.62	7	1.45	8	1.28	9	1.07	11	.877
H	7	1.80	8	1.68	9	1.49	10	1.31	12	1.11	14	.906
I	9	1.83	10	1.70	11	1.51	13	1.34	15	1.13	17	.924
J	12	1.88	14	1.75	15	1.56	18	1.38	20	1.17	24	.964
K	17	1.93	19	1.79	22	1.61	25	1.42	29	1.21	33	.995
L	25	1.97	28	1.84	32	1.65	36	1.46	42	1.24	49	1.03
M	33	2.00	36	1.86	42	1.67	48	1.48	55	1.26	64	1.05
N	49	2.03	54	1.89	61	1.69	70	1.51	82	1.29	95	1.07
P	65	2.04	71	1.89	81	1.70	93	1.51	109	1.29	127	1.07
	1.50		2.50		4.00		6.50		10.00			
	Acceptable Quality Levels (tightened inspection)											

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-2

Master Table for Reduced Inspection for Plans Based on Variability Known
(Single Specification Limit—Form 1)

Sample size code letter	Acceptable Quality Levels									
	.10		.15		.25		.40		.65	
	n	k	n	k	n	k	n	k	n	k
B	↓		↓		↓		↓		↓	
C										
D									↓	
E										
F							↓		2	1.36
G			↓		↓		2	1.58	2	1.42
H	↓		2	1.94	2	1.81	3	1.69	3	1.56
I	3	2.19	3	2.07	3	1.91	4	1.80	4	1.69
J	4	2.30	4	2.14	5	2.05	5	1.88	6	1.78
K	5	2.34	6	2.23	6	2.08	7	1.95	7	1.80
L	6	2.37	7	2.25	8	2.13	8	1.96	9	1.83
M	7	2.38	8	2.26	9	2.13	10	1.99	11	1.86
N	12	2.49	13	2.35	14	2.21	16	2.07	17	1.93
P	17	2.54	19	2.41	21	2.27	23	2.12	25	1.97

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-2—Continued

Master Table for Reduced Inspection for Plans Based on Variability Known
(Single Specification Limit—Form 1)

Sample size code letter	Acceptable Quality Levels											
	1.00		1.50		2.50		4.0		6.5		10.00	
	n	k	*n*	k	*n*	k	*n*	k	*n*	k	*n*	k
B	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
C	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
D	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
E	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
F	2	1.25	2	1.09	2	.936	3	.755	3	.573	4	.344
G	2	1.33	3	1.17	3	1.01	3	.825	4	.641	4	.429
H	3	1.44	4	1.28	4	1.11	5	.919	5	.728	6	.515
I	4	1.53	5	1.39	5	1.20	6	.991	7	.797	8	.584
J	6	1.62	7	1.45	8	1.28	9	1.07	11	.877	12	.649
K	8	1.68	9	1.49	10	1.31	12	1.11	14	.906	16	.685
L	10	1.70	11	1.51	13	1.34	15	1.13	17	.924	20	.706
M	12	1.72	13	1.53	15	1.35	18	1.15	21	.942	21	.719
N	19	1.79	22	1.61	25	1.42	29	1.21	33	.995	38	.770
P	28	1.84	32	1.65	36	1.46	42	1.24	49	1.03	56	.803

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as k value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Part II
DOUBLE SPECIFICATION LIMIT

D8. SAMPLING PLAN FOR DOUBLE SPECIFICATION LIMIT

This part of the Standard describes the procedures for use with plans for a double specification limit when variability of the lot with respect to the quality characteristic is known.

D8.1 Use of Sampling Plans. To determine whether the lot meets the acceptability criterion with respect to a particular quality characteristic and AQL value(s), the applicable sampling plan shall be used in accordance with the provisions of Section A, General Description of Sampling Plans, and those in this part of the Standard.

D8.2 Initial Review for Combined Double Specification Limits. Before implementing a sampling plan for combined double specification limits when the process variability is known, it is mandatory to carry out a check that the process standard deviation, σ, does not exceed the Maximum Process Standard Deviation (MPSD) derived from Table D-6 that corresponds to the specified AQL. If σ is greater than the MPSD, the process average is known to be excessive, and lots shall be judged not acceptable without samples being drawn. If σ does not exceed the MPSD, it is an indication that the process average may be acceptable, and sampling inspection should be carried out in order to determine lot acceptability. To make the comparison, the following procedure is recommended:

(1) Determine the standardized MPSD from Table D-6 for the given AQL.

(2) Multiply the standardized MPSD by the specification interval $U - L$ to obtain the MPSD.

(3) Compare the process standard deviation, σ, with this calculated MPSD.

D9. SELECTING THE SAMPLING PLAN

A sampling plan for each AQL value shall be selected from Table D-3 or D-4 as follows:

D9.1 Determination of Sample Size Code Letter. The sample size code letter shall be selected from Table A-2 in accordance with paragraph A7.1.

D9.2 Master Sampling Tables. The master sampling tables for plans based on variability known for a double specification limit are Tables D-3 and D-4. Table D-3 is used for normal and tightened inspection and Table D-4 for reduced inspection.

D9.3 Obtaining Sampling Plan. A sampling plan consists of a sample size and an associated maximum allowable percent nonconforming. The sampling plan to be applied in inspection shall be obtained from Master Table D-3 or D-4.

D9.3.1 Sample Size. The sample size n is shown in the master tables corresponding to each sample size code letter and AQL.

D9.3.2 Maximum Allowable Percent Nonconforming. The maximum allowable percent nonconforming for sample estimates of percent nonconforming for the lower, upper, or both specification limits combined, corresponding to the sample size mentioned in paragraph D9.3.1, is shown in the column of the master table corresponding to the applicable AQL value(s). If different AQLs are assigned to each specification limit, designate the maximum allowable percent nonconforming by M_L for the lower limit, and by M_U for the upper limit. If one AQL is assigned to both limits combined, designate the maximum allowable percent nonconforming by M. Table D-3 is entered from the top for normal inspection and from the bottom for tightened inspection. Sampling plans for reduced inspection are provided in Table D-4.

D10. DRAWING OF SAMPLES

Samples shall be selected in accordance with paragraph A7.2.

D11. LOT-BY-LOT ACCEPTABILITY PROCEDURES

D11.1 Acceptability Criterion. The degree of conformance of a quality characteristic with respect to a double specification limit shall be judged by the percent of nonconforming product. The percentage of nonconforming product is estimated by entering Table D-5 with the quality index.

D11.2 Computation of Quality Indices. The quality indices $Q_U = (U - \bar{X})v/\sigma$ and $Q_U = (\bar{X} - L)v/\sigma$ shall be computed, where

U is the upper specification limit,
L is the lower specification limit,
v is the factor provided in Tables D-3 and D-4,

$\bar{X}$ is the sample mean, and σ is the known variability.

D11.3 Percent Nonconforming in the Lot. The quality of a lot shall be expressed in terms of the lot percent nonconforming. Its estimate will be designated by p_L, p_U, or p. The estimate p_U indicates conformance with respect to the upper specification limit, p_L with respect to the lower specification limit, and p for both specification limits combined. The estimates p_L and p_U shall be determined by entering Table D-5, respectively with Q_L and Q_U. The estimate p shall be determined by adding the corresponding estimated percents nonconforming p_L and p_U found in the table.

D12. ACCEPTABILITY CRITERION AND SUMMARY FOR OPERATION OF SAMPLING PLANS

D12.1 One AQL value for both Upper and Lower Specification Limit Combined.

D12.1.1 Acceptability Criterion.[4] Compare the estimated lot percent nonconforming $p = p_U + p_L$ with the maximum allowable percent nonconforming M. If p is equal to or less than M, the lot meets the acceptability criterion; if p is greater than M or if Q_U or Q_L, or both are negative, then the lot does not meet the acceptability criterion.

D12.1.2 Summary of Operation of Sampling Plan. In cases where a single AQL value is established for the upper and lower specification limit combined for a single quality characteristic, the following steps summarize the procedures to be used:

(1) Determine the sample size code letter from Table A-2 by using the lot size and the inspection level.

(2) Select plan from Master Table D-3 or D-4. Obtain the sample size n, the factor v, and the maximum allowable percent nonconforming M.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit of the sample.

(4) Compute the sample mean $\bar{X}$.

(5) Compute the quality indices $Q_U = (U - \bar{X})v/\sigma$ and $Q_L = (\bar{X} - L)v/\sigma$.

(6) Determine the estimated lot percent nonconforming $p = p_U + p_U$ from Table D-5.

(7) If the estimated lot percent nonconforming p is equal to or less than the maximum allowable percent nonconforming M, the lot meets the acceptability criterion; if p is greater than M or if Q_U or Q_L or both are negative, then the lot does not meet the acceptability criterion.

D12.2 Different AQL Values for Upper and Lower Specification Limit.

D12.2.1 Acceptability Criteria.[5] Compare the estimated lot percents nonconforming p_L and p_U with the corresponding maximum allowable percents nonconforming M_L and M_U; also compare $p = p_L + p_U$ with the larger of M_L and M_U. If p_L is equal to or less than M_L, p_U is equal to or less than M_U, and p is equal to or less than the larger of M_L and M_U, the lot meets the acceptability criteria; otherwise, the lot does not meet the acceptability criteria. If either Q_L or Q_U or both are negative, then the lot does not meet the acceptability criteria.

D12.2.2 Summary of Operation of Sampling Plan. In cases where a different AQL value is established for the upper and lower specification limit for a single quality characteristic, the following steps summarize the procedures to be used:

(1) Determine the sample size code letter from Table A-2 by using the lot sizes and inspection level.

(2) Select the sampling plan from Master Table D-3 or D-4. Obtain the sample size n and the factor v, corresponding to the larger of the two AQL values, and also the maximum allowable percent nonconforming M_U and M_L, corresponding to the AQL values for the upper and lower specification limits, respectively.

(3) Select at random the sample of n units from the lot; inspect and record the measurement of the quality characteristic on each unit in the sample.

(4) Compute the sample mean $\bar{X}$.

(5) Compute the quality indices $Q_U = (U - \bar{X})v/\sigma$ and $Q_U = (\bar{X} - L)v/\sigma$.

[4]See Example D-3a for a complete example of this procedure.

[5]See Example D-4a for a complete example of this procedure.

(6) Determine the estimated lot percents nonconforming p_U and p_L corresponding to the percents nonconforming above the upper and below the lower specification limits. Also determine the combined percent nonconforming $p = p_U + p_L$.

(7) If all three of the following conditions:

(a) p_U is equal to or less than M_U,

(b) p_L is equal to or less than M_L,

(c) p is equal to or less than the larger of M_L and M_U,

are satisfied, the lot meets the acceptability criteria; otherwise, the lot does not meet the acceptability criteria. If either Q_L or Q_U or both are negative, then the lot does not meet the acceptability criteria.

EXAMPLE D-3a

Example of Calculations

Double Specification Limit

Variability Known

One AQL Value for Both Upper and Lower Specification Limit Combined

Example: The specified maximum and minimum yield points for certain steel castings are 67,000 and 58,000 psi, respectively. A lot of 500 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1.5% is to be used. The variability σ is known to be 3,000 psi.

Line	Information Needed	Value Obtained	Explanation
1	Upper Specification Limit: U	67,000	
2	Lower Specification Limit: L	58,000	
3	Known Variability: σ	3,000	
4	Factor for Maximum Process Standard Deviation for an AQL of 1.5%: $F\,\sigma$	0.194	See Table D-6
5	Maximum Process Standard Deviation: MPSD = $F\,\sigma\,(U - L)$	1,746	0.194 (67,000 – 58,000)
6	Mandatory check: Compare σ with MPSD	3,000 > 1,746	

The process fails the mandatory check that σ does not exceed the MPSD, so sampling inspection is pointless and submitted lots should not be accepted.

EXAMPLE D-3b
Example of Calculations
Double Specification Limit
Variability Known
One AQL Value for Both Upper and Lower Specification Limit Combined

Example: The specified maximum and minimum yield points for certain steel castings are 70,000 and 54,000 psi, respectively. A lot of 500 items is submitted for inspection. Inspection Level II, normal inspection, with AQL = 1.5% is to be used. The variability σ is known to be 3,000 psi.

Line	Information Needed	Value Obtained	Explanation
1	Upper Specification Limit: U	70,000	
2	Lower Specification Limit: L	54,000	
3	Known Variability: σ	3,000	
4	Factor for Maximum Process Standard Deviation for an AQL of 1.5%: $F\,\sigma$	0.194	See Table D-6
5	Maximum Process Standard Deviation: MPSD = $F\,\sigma\,(U - L)$	3,104	0.194 (70,000 – 54,000)
6	Mandatory check: Compare σ with MPSD	3,000 > 3,104	

The process satisfies the mandatory check that σ does not exceed the MPSD. It follows that there is a possibility, though not a certainty, that the lot is acceptable. Lot acceptability is determined by sampling. From Tables A-2 and D-3, it is seen that a sample of size 10 is required. Suppose the yield points of the sample specimens are:

62,500; 60,500; 68,000; 59,000; 65,500;
62,000; 61,000; 69,000; 58,000; 64,500;

and compliance with the acceptability criterion is to be determined.

Line	Information Needed	Value Obtained	Explanation
7	Sample size: n	10	See Tables A-2 and D-3
8	Sum of Measurements: ΣX	630,000	
9	Sample Mean: $\bar{X} = \Sigma X/n$	63,000	630,000/10
10	Factor: v	1.054	See Table D-3
11	Quality Index: $Q_U = (U - \bar{X})v/\sigma$	2.459	(70,000 – 63,000) 1.054/3,000
12	Quality Index: $Q_L = (\bar{X} - L)v/\sigma$	3,162	(63,000 – 54,000) 1.054/3,000
13	Est. of Lot % Ncf. Above U: p_U	0.697%	See Table D-5
14	Est. of Lot % Ncf. Below L: p_L	0.078%	See Table D-5
15	Total Est. % Ncf. in Lot: $p = p_U + p_L$	0.775%	0.697% + 0.078%
16	Max. Allowable Est. % Ncf.: M	3.63%	See Table D-3
17	Acceptability Criterion: Compare p with M	0.775% < 3.63%	

The lot meets the acceptability criterion, since $p = p_U + p_L$ is less than M.

EXAMPLE D-4

Example of Calculations

Double Specification Limit

Variability Known

Different AQL Values for Upper and Lower Specification Limits

Example: The specified maximum and minimum yield points for certain steel castings are 67,000 psi and 58,000 psi, respectively. A lot of 500 items is submitted for inspection. Inspection Level II, normal inspection with AQL = 1% for the upper and AQL = 2.5% for the lower specification limit is to be used. The variability σ is known to be 3,000 psi. From Tables A-2 and D-3 it is seen that a sample of size 11 corresponding to the sample size code letter, I, and the AQL value of 2.5% is required. Suppose the yield points of the sample specimens are:

62,500; 60,500; 64,000; 59,000; 65,500;
62,000; 61,000; 60,631; 68,000; 62,000; 63,000

and compliance with the acceptability criteria is to be determined.

Line	Information Needed	Value Obtained	Explanation
1	Sample Size: n	11	
2	Known Variability: σ	3,000	
3	Sum of Measurements: ΣX	678,131	
4	Sample Mean $\bar{X}$:$\Sigma X/n$	61,648	678,131/11
5	Factor: v	1.049	See Table D-3
6	Upper Specification Limit: U	67,000	
7	Lower Specification Limit: L	58,000	
8	Quality Index: $Q_U = (U - \bar{X})v/\sigma$	1.87	(67,000 – 61,648)1.049/3,000
9	Quality Index: $Q_L = (\bar{X} - L)v/\sigma$	1.28	(61,648 – 58,000)1.049/3,000
10	Est. of Lot Percent Ncf. Above U: p_U	3.07%	See Table D-5
11	Est. of Lot Percent Ncf. Below L: p_L	10.03%	See Table D-5
12	Total Est. Percent Ncf. in Lot $p = p_U + p_L$	13.10%	3.07% + 10.03%
13	Max. Allowable Percent Ncf. Above U: M_U	2.59%	See Table D-3
14	Max. Allowable Percent Ncf. Below L: M_L	5.60%	See Table D-3
15	Acceptability Criteria:		
	(a) Compare p_U with M_U	3.07% > 2.59%	See Para. D12.2.2(7)(a)
	(b) Compare p_L with M_L	10.03% > 5.60%	See Para. D12.2.2(7)(b)
	(c) Compare p with M_L	13.10% > 5.60%	See Para. D12.2.2(7)(c)

The lot does not meet the acceptability criteria, since 15(a), (b) and (c) are not satisfied; i.e., $p_U > M_U$, $p_L > M_L$, and $p > M_L$.

Table D-3

Master Table for Normal and Tightened Inspection for Plans Based on Known Variability (Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Acceptable Quality Levels (normal inspection)																	
	T			.10			.15			.25			.40			.65		
	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v
B		↓			↓			↓			↓			↓			↓	
C		↓			↓			↓			↓			↓			↓	
D		↓			↓			↓			↓			↓		2	1.28	1.414
E		↓			↓			↓		2	.310	1.414	2	.510	1.414	4	1.94	1.225
F		↓			↓		3	.369	1.225	3	.568	1.225	3	.959	1.225	4	1.88	1.155
G	3	.114	1.225	4	.290	1.155	4	.399	1.155	4	.681	1.155	5	1.09	1.118	5	1.76	1.118
H	4	.161	1.155	5	.296	1.118	5	.445	1.118	6	.721	1.095	6	1.14	1.095	7	1.75	1.080
I	6	.230	1.095	6	.321	1.095	6	.478	1.095	7	.756	1.080	8	1.14	1.069	8	1.80	1.069
J	7	.226	1.080	8	.330	1.069	9	.469	1.061	9	.760	1.061	10	1.14	1.054	11	1.73	1.049
K	11	.217	1.049	11	.326	1.049	12	.461	1.045	13	.721	1.041	14	1.08	1.038	16	1.62	1.033
L	15	.211	1.035	16	.308	1.033	17	.438	1.031	19	.673	1.027	21	1.00	1.025	23	1.51	1.023
M	20	.207	1.026	22	.296	1.024	23	.423	1.023	25	.655	1.021	27	.980	1.019	30	1.47	1.017
N	30	.193	1.017	31	.283	1.017	34	.397	1.015	37	.615	1.014	40	.921	1.013	44	1.39	1.012
P	40	.196	1.013	42	.285	1.012	45	.402	1.011	49	.620	1.010	54	.920	1.009	59	1.39	1.009
	.10			.15			.25			.40			.65			1.00		
	Acceptable Quality Levels (tightened inspection)																	

All AQL values are in percent nonconforming. T denotes plan used exclusively on tightened inspection and provides symbol for identification of appropriate OC curve.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-3—Continued

Master Table for Normal and Tightened Inspection for Plans Based on Known Variability
(Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Acceptable Quality Levels (normal inspection)																	
	1.00			1.50			2.50			4.00			6.50			10.00		
	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v
B		↓			↓			↓			↓			↓			↓	
C	2	2.73	1.414	2	3.90	1.414	2	6.11	1.414	2	9.27	1.414	3	17.74	1.225	3	24.22	1.225
D	2	2.23	1.414	2	3.00	1.414	3	7.56	1.225	3	10.79	1.225	3	15.60	1.225	4	22.97	1.155
E	3	2.76	1.225	3	3.85	1.225	4	6.99	1.155	4	9.97	1.155	5	15.21	1.118	5	20.80	1.118
F	4	2.58	1.155	4	3.87	1.155	5	6.05	1.118	5	8.92	1.118	6	13.89	1.095	7	19.46	1.080
G	6	2.57	1.095	6	3.77	1.095	7	5.83	1.080	8	8.62	1.069	9	12.88	1.061	11	17.88	1.049
H	7	2.62	1.080	8	3.68	1.069	9	5.68	1.061	10	8.43	1.054	12	12.35	1.045	14	17.36	1.038
I	9	2.59	1.061	10	3.63	1.054	11	5.60	1.049	13	8.13	1.041	15	12.04	1.035	17	17.05	1.031
J	12	2.49	1.045	14	3.43	1.038	15	5.34	1.035	18	7.72	1.029	20	11.57	1.026	24	16.23	1.022
K	17	2.35	1.031	19	3.28	1.027	22	4.98	1.024	25	7.34	1.021	29	10.93	1.018	33	15.61	1.016
L	25	2.19	1.021	28	3.05	1.018	32	4.68	1.016	36	6.95	1.014	42	10.40	1.012	49	14.87	1.010
M	33	2.12	1.016	36	2.99	1.014	42	4.55	1.012	48	6.75	1.011	55	10.17	1.009	64	14.58	1.008
N	49	2.00	1.010	54	2.82	1.009	61	4.35	1.008	70	6.48	1.007	82	9.76	1.006	95	14.09	1.005
P	65	2.00	1.008	71	2.82	1.007	81	4.34	1.006	93	6.46	1.005	1.09	9.73	1.005	127	14.02	1.004
	1.50			2.50			4.00			6.50			10.00					
	Acceptable Quality Levels (tightened inspection)																	

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-4

Master Table for Reduced Inspection for Plans Based on Known Variability
(Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Acceptable Quality Levels														
	.10			.15			.25			.40			.65		
	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v
B		↓			↓			↓			↓			↓	
C		↓			↓			↓			↓			↓	
D		↓			↓			↓			↓			↓	
E		↓			↓			↓			↓			↓	
F		↓			↓			↓			↓		2	2.73	1.414
G		↓			↓			↓		2	1.28	1.414	2	2.23	1.414
H		↓		2	.310	1.414	2	.510	1.414	3	1.94	1.225	3	2.76	1.225
I	3	.369	1.225	3	.568	1.225	3	.959	1.225	4	1.88	1.155	4	2.58	1.155
J	4	.399	1.155	4	.681	1.155	5	1.09	1.118	5	1.76	1.118	6	2.57	1.095
K	5	.445	1.118	6	.721	1.095	6	1.14	1.095	7	1.75	1.080	7	2.62	1.080
L	6	.478	1.095	7	.756	1.080	8	1.14	1.069	8	1.80	1.069	9	2.59	1.061
M	7	.507	1.080	8	.791	1.069	9	1.18	1.061	10	1.79	1.054	11	2.57	1.049
N	12	.461	1.045	13	.721	1.041	14	1.08	1.038	16	1.62	1.033	17	2.35	1.031
P	17	.438	1.031	19	.673	1.027	21	1.00	1.025	23	1.51	1.023	25	2.19	1.021

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-4— Continued

Master Table for Reduced Inspection for Plans Based on Known Variability
(Double Specification Limit and Form 2—Single Specification Limit)

Sample size code letter	Acceptable Quality Levels																	
	1.00			1.50			2.50			4.0			6.5			10.00		
	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v	n	M	v
B	↓			↓			↓			↓			↓			↓		
C	↓			↓			↓			↓			↓			↓		
D	↓			↓			↓			↓			↓			↓		
E	↓			↓			↓			↓			↓			↓		
F	2	3.90	1.414	2	6.11	1.414	2	9.27	1.414	3	17.74	1.225	3	24.22	1.225	4	33.67	1.225
G	2	3.00	1.414	3	7.56	1.225	3	10.79	1.225	3	15.60	1.225	4	22.97	1.155	4	31.01	1.155
H	3	3.85	1.225	4	6.99	1.155	4	9.97	1.155	5	15.21	1.118	5	20.80	1.118	6	28.64	1.095
I	4	3.87	1.155	5	6.05	1.118	5	8.92	1.118	6	13.89	1.095	7	19.46	1.080	8	26.64	1.069
J	6	3.77	1.095	7	5.83	1.080	8	8.62	1.069	9	12.88	1.061	11	17.88	1.049	12	24.88	1.045
K	8	3.68	1.069	9	5.68	1.061	10	8.43	1.054	12	12.35	1.045	14	17.36	1.038	16	23.96	1.033
L	10	3.63	1.054	11	5.60	1.049	13	8.13	1.041	15	12.04	1.035	17	17.05	1.031	20	23.43	1.026
M	12	3.61	1.045	13	5.58	1.041	15	8.13	1.035	18	11.88	1.029	21	16.71	1.025	24	23.13	1.022
N	19	3.28	1.027	22	4.98	1.024	25	7.34	1.021	29	10.93	1.018	33	15.61	1.016	38	21.77	1.013
P	28	3.05	1.018	32	4.68	1.016	36	6.95	1.014	42	10.40	1.012	49	14.87	1.010	56	20.90	1.009

All AQL values are in percent nonconforming.

↓ Use first sampling plan below arrow; that is, both sample size as well as M value. When sample size equals or exceeds lot size, every item in the lot must be inspected.

Table D-5

Table for Estimating the Lot Percentage Nonconforming for Plans Based on Known Variability[1]

Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L		Q_U or Q_L	
.00	50.000																										
.01	49.601	.26	39.743	.51	30.503	.76	22.363	1.01	15.625	1.26	10.383	1.51	06.552	1.76	03.920	2.01	02.222	2.26	01.191	2.51	00.604	2.76	00.289	3.01	00.131	3.26	00.056	3.51	00.022	3.76	00.008
.02	49.202	.27	39.358	.52	30.153	.77	22.065	1.02	15.386	1.27	10.204	1.52	06.426	1.77	03.836	2.02	02.169	2.27	01.160	2.52	00.587	2.77	00.280	3.02	00.126	3.27	00.054	3.52	00.022	3.77	00.008
.03	48.803	.28	38.974	.53	29.806	.78	21.770	1.03	15.150	1.28	10.027	1.53	06.301	1.78	03.754	2.03	02.118	2.28	01.130	2.53	00.570	2.78	00.272	3.03	00.122	3.28	00.052	3.53	00.021	3.78	00.008
.04	48.405	.29	38.591	.54	29.460	.79	21.476	1.04	14.917	1.29	09.853	1.54	06.178	1.79	03.673	2.04	02.068	2.29	01.101	2.54	00.554	2.79	00.264	3.04	00.118	3.29	00.050	3.54	00.020	3.79	00.008
.05	48.006	.30	38.209	.55	29.116	.80	21.186	1.05	14.686	1.30	09.860	1.55	06.057	1.80	03.593	2.05	02.018	2.30	01.072	2.55	00.539	2.80	00.256	3.05	00.114	3.30	00.048	3.55	00.019	3.80	00.007
.06	47.608	.31	37.828	.56	28.774	.81	20.897	1.06	14.457	1.31	09.510	1.56	05.938	1.81	03.515	2.06	01.970	2.31	01.044	2.56	00.523	2.81	00.248	3.06	00.111	3.31	00.047	3.56	00.019	3.81	00.007
.07	47.210	.32	37.448	.57	28.434	.82	20.611	1.07	14.231	1.32	09.342	1.57	05.821	1.82	03.438	2.07	01.923	2.32	01.017	2.57	00.508	2.82	00.240	3.07	00.107	3.32	00.045	3.57	00.018	3.82	00.007
.08	46.812	.33	37.070	.58	28.096	.83	20.327	1.08	14.007	1.33	09.176	1.58	05.705	1.83	03.362	2.08	01.876	2.33	00.990	2.58	00.494	2.83	00.233	3.08	00.103	3.33	00.043	3.58	00.017	3.83	00.006
.09	46.414	.34	36.693	.59	27.760	.84	20.045	1.09	13.786	1.34	09.012	1.59	05.592	1.84	03.288	2.09	01.831	2.34	00.964	2.59	00.480	2.84	00.226	3.09	00.100	3.34	00.042	3.59	00.017	3.84	00.006
.10	46.017	.35	36.317	.60	27.425	.85	19.766	1.10	13.567	1.35	08.851	1.60	05.480	1.85	03.216	2.10	01.786	2.35	00.939	2.60	00.466	2.85	00.219	3.10	00.097	3.35	00.040	3.60	00.016	3.85	00.006
.11	45.620	.36	35.942	.61	27.093	.86	19.489	1.11	13.350	1.36	08.691	1.61	05.370	1.86	03.144	2.11	01.743	2.36	00.914	2.61	00.453	2.86	00.212	3.11	00.094	3.36	00.039	3.61	00.015	3.86	00.006
.12	45.224	.37	35.569	.62	26.763	.87	19.215	1.12	13.136	1.37	08.534	1.62	25.262	1.87	03.074	2.12	01.700	2.37	00.889	2.62	00.440	2.87	00.205	3.12	00.090	3.37	00.038	3.62	00.015	3.87	00.005
.13	44.828	.38	35.197	.63	26.435	.88	18.943	1.13	12.924	1.38	08.379	1.63	05.155	1.88	03.005	2.13	01.659	2.38	00.866	2.63	00.427	2.88	00.199	3.13	00.087	3.38	00.036	3.63	00.014	3.88	00.005
.14	44.433	.39	34.827	.64	26.109	.89	18.673	1.14	12.714	1.39	08.226	1.64	05.050	1.89	02.938	2.14	01.618	2.39	00.842	2.64	00.415	2.89	00.193	3.14	00.084	3.39	00.035	3.64	00.014	3.89	00.005
.15	44.038	.40	34.458	.65	25.785	.90	18.406	1.15	12.507	1.40	08.076	1.65	04.947	1.90	02.872	2.15	01.578	2.40	00.820	2.65	00.402	2.90	00.187	3.15	00.082	3.40	00.034	3.65	00.013	3.90	00.005
.16	43.644	.41	34.090	.66	25.463	.91	18.141	1.16	12.302	1.41	07.927	1.66	04.846	1.91	02.807	2.16	01.539	2.41	00.798	2.66	00.391	2.91	00.181	3.16	00.079	3.41	00.032	3.66	00.013	3.91	00.005
.17	43.251	.42	33.724	.67	25.143	.92	17.879	1.17	12.100	1.42	07.780	1.67	04.746	1.92	02.743	2.17	01.500	2.42	00.776	2.67	00.379	2.92	00.175	3.17	00.076	3.42	00.031	3.67	00.012	3.92	00.004
.18	42.858	.43	33.360	.68	24.825	.93	17.619	1.18	11.900	1.43	07.636	1.68	04.648	1.93	02.680	2.18	01.463	2.43	00.755	2.68	00.368	2.93	00.169	3.18	00.074	3.43	00.030	3.68	00.012	3.93	00.004
.19	42.465	.44	32.997	.69	24.510	.94	17.361	1.19	11.702	1.44	07.493	1.69	04.551	1.94	02.619	2.19	01.426	2.44	00.734	2.69	00.357	2.94	00.164	3.19	00.071	3.44	00.029	3.69	00.011	3.94	00.004
.20	42.074	.45	32.636	.70	24.196	.95	17.106	1.20	11.507	1.45	07.353	1.70	04.457	1.95	02.559	2.20	01.390	2.45	00.714	2.70	00.347	2.95	00.159	3.20	00.069	3.45	00.028	3.70	00.011	3.95	00.004
.21	41.683	.46	32.276	.71	23.885	.96	16.853	1.21	11.314	1.46	07.214	1.71	04.363	1.96	02.500	2.21	01.355	2.46	00.695	2.71	00.336	2.96	00.154	3.21	00.066	3.46	00.027	3.71	00.010	3.96	00.004
.22	41.294	.47	31.918	.72	23.576	.97	16.602	1.22	11.123	1.47	07.078	1.72	04.272	1.97	02.442	2.22	01.321	2.47	00.676	2.72	00.326	2.97	00.149	3.22	00.064	3.47	00.026	3.72	00.010	3.97	00.004
.23	40.905	.48	31.561	.73	23.270	.98	16.354	1.23	10.935	1.48	06.944	1.73	04.182	1.98	02.385	2.23	01.287	2.48	00.657	2.73	00.317	2.98	00.144	3.23	00.062	3.48	00.025	3.73	00.010	3.98	00.003
.24	40.517	.49	31.207	.74	22.965	.99	16.109	1.24	10.749	1.49	06.811	1.74	04.093	1.99	02.330	2.24	01.255	2.49	00.639	2.74	00.307	2.99	00.139	3.24	00.060	3.49	00.024	3.74	00.009	3.99	00.003
.25	40.129	.50	30.854	.75	22.663	1.00	15.866	1.25	10.565	1.50	06.681	1.75	04.006	2.00	02.275	2.25	01.222	2.50	00.621	2.75	00.298	3.00	00.135	3.25	00.058	3.50	00.023	3.75	00.009	4.00	00.003

[1]Values tabulated are read in percent.

Table D-6
Value of $F\sigma$ for Maximum Process Standard Deviation

AQL (% Ncf)	.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.0
$F\sigma$	0.147	0.152	0.157	0.165	0.174	0.184	0.194	0.206	0.223	0.243	0.271

The MPSD may be obtained by multiplying the factor $F\sigma$ by the difference between the upper specification limit U and the lower specification limit L. The formula is MPSD = $F\sigma$ (U – L).

The MPSD indicates the greatest allowable magnitude of the process standard deviation when using plans for the double specification limit case with known variability. If the process standard deviation is less than the MPSD, there is a possibility but not a certainty that the lot will be accepted.

APPENDIX D
Definitions

Symbol	Read	Definitions
n		Sample size for a single lot.
$\bar{X}$	X bar	Sample mean. Arithmetic mean of sample measurements from a single lot.
σ	Sigma	Known variability. The predetermined variability of the quality characteristic which will be used with the variability known acceptability plans.
U		Upper specification limit.
L		Lower specification limit.
k		The acceptability constant given in Tables D-1 and D-2.
v		A factor used in determining the quality indices when using the known variability acceptability plan. The v values are given in TAbles D-3 and D-4.
Q_U	Q sub U	Quality Index for use with Table D-5.
Q_L	Q sub L	Quality Index for use with Table D-5.
p_U	p sub U	Sample estimate of the lot percent nonconforming above U from Table D-5.
p_L	p sub L	Sample estimate of the lot percent nonconforming below L from Table D-5.
p		Total sample estimate of the lot percent nonconforming $p = p_U + p_L$.
M		Maximum allowable percent nonconforming for sample estimates given in Tables D-3 and D-4.
M_U	M sub U	Maximum allowable percent nonconforming above U given in Tables D-3 and D-4. (For use when different AQL values for U and L are specified.)
M_L	M sub L	Maximum allowable percent nonconforming below L given in Tables D-3 and D-4. (For use when different AQL values for U and L are specified.)
$\bar{p}$	p bar	Sample estimates of the process percent nonconforming, i.e., the estimated process average.
$\bar{p}_U$	p bar sub U	The estimated process average for an upper specification limit.
$\bar{p}_L$	p bar sub L	The estimated process average for a lower specification limit.
<	Less than	Less than.
>	Greater than	Greater than.
Σ	Sum of	Sum of.
T		AQL symbol denoting plan used exclusively on tightened inspection (provides identification of appropriate OC curve).

SECTION E
APPENDIX
Match with ANSI Z1.4

E1. INTRODUCTION

The original version of this variables inspection standard (Z1.9-1972) corresponded directly to the military standard MIL-STD-414 dated 11 June 1957, just as the attributes inspection standard ANSI Z1.4 corresponded to MIL-STD-105D, dated 29 April 1963. The plans contained in these variables and attributes standards were, however, not matched. Subsequent to the promulgation of these standards, the International Organization for Standardization Working Group C, in June 1974, presented a procedure for roughly matching the MIL-STD-414 and MIL-STD-105D Normal plans by a realignment of the MIL-STD-414 code letters.* It is this realignment which is used as a basis of the present ANSI/ASQC Z1.9-1993.

The extent to which the plans of ANSI/ASQC Z1.9-1993 match those of Z1.4 is shown in the following tables which give:

Table 1—Matching Code Letters Table
Table 2—ANSI/ASQC Z1.9-1993 percentage points for the 95, 50, 10th percentiles.
Table 3—ANSI Z1.4 percentage points for the 95, 50, 10th percentiles.
Table 4—Difference between ANSI/ASQC Z1.9-1993 and Z1.4 percentiles.

The percentage points are the percents nonconforming having probability of acceptance equal to the percentiles shown. Table 4 can be employed by the user to determine the practical significance of the difference in the operating characteristics of the corresponding plans in ANSI Z1.4 and ANSI/ASQC Z1.9-1993.

Procedures for switching to and from tightened or reduced inspection were taken directly from MIL-STD-105D, eliminating the use of limit numbers for reduced inspection and also the procedure allowing termination of reduced inspection without either acceptance or rejection criteria being met.

E2. TABLES

Tables showing the extent to which ANSI/ASQC Z1.9-1993 matches Z1.4 follow.

*Working Group C, ISO/TC69, "Sampling by Variables," April 1974, Draft.

E2—Tables

Table 1
Matching Code Letters and
ANSI/ASQC Z1.9 Sample Size

Z1.9-1993 Sample Size, Normal Inspection, Level II	Z1.9-1993 New Code Letter	Z1.9-1993 (414) Old Code Letter	Z1.4 (105D) Matched Code Letter
3	B	B	B
4	C	C	C
5	D	D	D
7	E	E	E
10	F	F	F
15	G	G	G
20	H	H	H
25	I	I	H
35	J	K	J
50	K	M	K
75	L	N	L
100	M	O	M
150	N	P	N
200	P	Q	P

Table 2

ANSI/ASQC Z1.9-1993 Percentage Points in Terms of Percent Nonconforming

Probability of Acceptance	Z1.9-1993 Code Letter	Acceptable Quality Level										
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
95.0									1.04	1.89	3.52	6.02
50.0	B								16.68	20.30	25.22	30.97
10.0									49.34	52.83	57.24	62.08
95.0							.44	.69	1.32	2.29	4.13	6.85
50.0	C						9.52	11.28	14.44	17.93	22.89	28.61
10.0							34.88	37.26	41.15	45.05	50.13	55.55
95.0						.28	.46	.77	1.38	2.43	4.30	7.11
50.0	D					6.34	7.82	9.71	12.47	15.97	20.75	26.40
10.0						25.94	28.40	31.24	34.98	39.25	44.55	50.32
95.0				.11	.18	.32	.53	.83	1.50	2.65	4.57	7.46
50.0	E			2.89	3.72	4.83	6.18	7.69	10.28	13.66	18.11	23.53
10.0				14.42	16.33	18.60	21.09	23.58	27.43	31.93	37.28	43.25
95.0			.07	.12	.21	.36	.57	.94	1.65	2.83	4.84	7.81
50.0	F		1.53	2.08	2.79	3.77	4.82	6.33	8.62	11.69	15.91	21.09
10.0			7.95	9.44	11.15	13.23	15.23	17.84	21.40	25.66	30.99	36.98
95.0		.06	.09	.15	.25	.45	.68	1.09	1.91	3.09	5.30	8.41
50.0	G	.90	1.17	1.57	2.20	3.09	3.99	5.32	7.51	10.15	14.27	19.25
10.0		4.31	5.07	6.13	7.58	9.41	11.12	13.38	16.77	20.48	25.76	31.63
95.0		.07	.11	.17	.29	.49	.79	1.21	2.07	3.39	5.69	8.88
50.0	H	.76	1.01	1.38	1.90	2.69	3.66	4.81	6.86	9.51	13.49	18.31
10.0		3.16	3.85	4.73	5.88	7.46	9.23	11.14	14.25	17.94	23.01	28.70
95.0		.08	.12	.20	.32	.56	.85	1.28	2.23	3.61	5.98	9.27
50.0	I	.68	.89	1.28	1.73	2.53	3.39	4.47	6.54	9.12	13.00	17.74
10.0		2.55	3.08	3.99	4.93	6.46	7.97	9.73	12.81	16.34	21.24	26.82
95.0		.09	.13	.23	.36	.60	.94	1.40	2.38	3.80	6.21	9.65
50.0	J	.59	.76	1.10	1.54	2.21	3.05	4.05	5.98	8.41	12.10	16.82
10.0		1.90	2.29	3.02	3.87	5.10	6.50	8.07	10.85	14.11	18.71	24.23
95.0		.10	.15	.26	.40	.64	1.02	1.49	2.51	4.04	6.52	10.00
50.0	K	.19	.65	.98	1.37	1.94	2.76	3.68	5.48	7.90	11.45	16.00
10.0		1.36	1.70	2.35	3.07	4.03	5.33	6.72	9.23	12.39	16.72	21.98
95.0		.11	.17	.27	.43	.70	1.06	1.58	2.62	4.18	6.81	10.34
50.0	L	.40	.56	.82	1.19	1.74	2.43	3.34	5.02	7.29	10.84	15.24
10.0		.97	1.27	1.74	2.37	3.24	4.28	5.58	7.82	10.70	14.94	19.95
95.0		.12	.18	.29	.47	.74	1.12	1.66	2.73	4.31	6.97	10.51
50.0	M	.37	.51	.77	1.12	1.64	2.31	3.18	4.80	7.00	10.45	14.75
10.0		.80	1.05	1.50	2.06	2.86	3.81	5.01	7.11	9.84	13.89	18.73
95.0		.13	.19	.31	.48	.77	1.18	1.73	2.82	4.41	7.07	10.80
50.0	N	.32	.46	.69	1.00	1.48	2.14	2.96	4.49	6.59	9.90	14.28
10.0		.62	.85	1.21	1.68	2.36	3.26	4.34	6.26	8.78	12.58	17.44
95.0		.143	.210	.344	.534	.84	1.25	1.86	3.00	4.66	7.40	11.22
50.0	P	.321	.445	.683	1.000	1.48	2.08	2.96	4.48	6.58	9.88	14.27
10.0		.571	.763	1.116	1.567	2.22	3.02	4.12	5.98	8.45	12.19	16.98

Table 3

ANSI/ASQC Z1.4 (MIL-STD-105D) Percentage Points in Terms of Percent Nonconforming

Probability of Acceptance	Z1.4 Code Letter	Acceptable Quality Level										
		.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
95.0										1.70		
50.0	B									20.6		
10.0										53.6		
95.0									1.02			7.63
50.0	C								12.9			31.4
10.0									36.9			58.4
95.0								.64			2.64	11.1
50.0	D							8.30			20.1	32.1
10.0								25.0			40.6	53.9
95.0							.394			2.81	6.63	11.3
50.0	E						5.19			12.6	20.0	27.5
10.0							16.2			26.8	36.0	44.4
95.0						.256			1.80	4.22	7.13	14.0
50.0	F					3.41			8.25	13.1	18.1	27.9
10.0						10.9			18.1	24.5	30.4	41.9
95.0					.161			1.13	2.59	4.39	8.50	13.1
50.0	G				2.14			5.19	8.29	11.4	17.5	23.7
10.0					6.94			13.38	15.8	19.7	27.1	34.1
95.0				.103			.712	1.66	2.77	5.34	8.20	12.9
50.0	H			1.38			3.33	5.31	7.30	11.3	15.2	21.2
10.0				4.50			7.56	10.3	12.9	17.8	22.4	29.1
95.0			.064			.444	1.03	1.73	3.32	5.06	7.91	11.9
50.0	J		.863			2.09	3.33	4.57	7.06	9.55	13.3	18.3
10.0			2.84			4.78	6.52	8.16	11.3	14.2	18.6	24.2
95.0		.0410			.284	.654	1.09	2.09	3.19	4.94	7.40	11.9
50.0	K	.554			1.34	2.14	2.94	4.54	6.14	8.53	11.7	17.3
10.0		1.84			3.11	4.26	5.35	7.42	9.42	12.3	16.1	22.5
95.0				.178	.409	.683	1.31	1.99	3.09	4.62	7.45	
50.0	L			.839	1.34	1.84	2.84	3.84	5.33	7.33	10.8	
10.0				1.95	2.66	3.34	4.64	5.89	7.70	10.1	14.1	
95.0			.112	.259	.433	.829	1.26	1.96	2.94	4.73		
50.0	M		.532	.848	1.17	1.80	2.43	3.39	4.66	6.88		
10.0			1.23	1.69	2.12	2.94	3.74	4.89	6.39	8.95		
95.0		.071	.164	.273	.523	.796	1.23	1.85	2.98			
50.0	N	.336	.535	.734	1.13	1.53	2.13	2.93	4.33			
10.0		.778	1.06	1.34	1.86	2.35	3.08	4.03	5.64			
95.0		.102	.171	.327	.498	.771	1.16	1.86				
50.0	P	.334	.459	.709	.959	1.33	1.83	2.71				
10.0		.665	.835	1.16	1.47	1.93	2.52	3.52				
95.0		.109	.209	.318	.494	.740	1.19					
50.0	Q	.294	.454	.614	.853	1.17	1.73					
10.0		.534	.742	.942	1.23	1.61	2.25					
95.0		.131	.199	.309	.462	.745						
50.0	Q	.284	.384	.533	.733	1.08						
10.0		.464	.589	.770	1.01	1.41						

Table 4

Difference in Percentage Points—ANSI/ASQC Z1.9-1993 Minus Z1.4 (105D)

Probability of Acceptance	Z1.4 Code Letter	Z1.9-1993 Code Letter	Acceptable Quality Level										
			.10	.15	.25	.40	.65	1.00	1.50	2.50	4.00	6.50	10.00
95.0											.19		
50.0	B	B									−.30		
10.0											−.77		
95.0										.30			−.78
50.0	C	C								1.54			−2.79
10.0										4.25			−2.85
95.0									.13			1.66	−3.99
50.0	D	D							1.41			.65	−5.70
10.0									6.24			3.95	−3.58
95.0								.136			−.16	−2.06	−3.84
50.0	E	E						.99			1.06	−1.89	−5.70
10.0								4.89			5.13	1.28	−1.15
95.0							.104			−.15	−1.39	−2.29	−6.19
50.0	F	F					.36			.37	−1.41	−2.19	−6.81
10.0							2.33			3.30	1.16	.59	−4.52
95.0						.089			−.04	−.68	−1.30	−3.20	−4.69
50.0	G	G				.06			.13	−.76	−1.25	−3.23	−4.45
10.0						.64			1.78	.97	.78	−1.34	−2.47
95.0					.067			.078	−.45	−.70	−1.95	−2.51	−4.02
50.0	H	H			.000			.33	−.50	−.44	−1.79	−1.71	−2.89
10.0					.23			1.67	.84	1.35	.14	.61	−.40
95.0								.138	−.38	−.54	−1.73	−2.22	−3.63
50.0	I	I						.06	−.84	−.76	−2.18	−2.20	−3.46
10.0								.41	−.57	−.09	−1.46	−1.16	−2.28
95.0				.066			.156	−.09	−.33	−.94	−1.26	−1.70	−2.25
50.0	J	J		−.103			.12	−.28	−.52	−1.08	−1.14	−1.20	−1.48
10.0				−.55			.32	−.02	−.09	−.45	−.09	.11	.03
95.0			.059			.116	−.014	−.07	−.60	−.68	−.90	−.88	−1.90
50.0	K	K	−.364			.03	−.20	−.18	−.86	−.66	−.63	−.25	−1.30
10.0			−.48			−.04	−.23	−.02	−.70	−.19	.09	.62	−.52
95.0					.092	.021	.017	−.25	−.41	−.47	−.44	−.64	
50.0	L	L			−.019	−.15	−.10	−.41	−.50	−.31	−.04	.04	
10.0					−.21	−.29	−.10	−.36	−.31	.12	.60	.84	
95.0				.068	.031	.037	−.089	−.14	−.30	−.21	−.42		
50.0	M	M		−.022	−.078	−.05	−.16	−.12	−.21	.14	.12		
10.0				−.18	−.19	−.06	−.08	.07	.12	.72	.89		
95.0			.059	.026	.037	−.043	−.026	−.05	−.12	−.16			
50.0	N	N	−.016	−.075	−.044	−.13	−.05	.01	.03	.16			
10.0			−.158	−.21	−.13	−.18	−.01	.18	.31	.62			
95.0			.041	.039	.017	.036	.069	.09	.00				
50.0	P	P	−.013	−.014	−.026	.041	.15	.25	.25				
10.0			−.094	−.072	−.044	.097	.29	.50	.60				